SIMOTICS L-1FN3 Linear Motors

Operating Instructions · 03/2012

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Drive Technology
SIMOTICS L-1FN3 Linear Motors

Operating Instructions

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Appendix A

03/2012

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Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE

indicates that an unintended result or situation can occur if the relevant information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Introduction 1

These operating instructions describe the motor and explain how to handle the motor from the delivery to the disposal stage.

Before you start using the motor, you must read these operating instructions to ensure safe, problem-free operation and to maximize the service life.

These operating instructions complement the relevant Siemens configuration manual. You can also request all descriptions and safety instructions from your local Siemens office.

Always follow the safety instructions and notices in these operating instructions. The warning notice system is explained on the rear of the inside front.

These operating instructions should be kept in a location where they can be easily accessed and made available to the personnel responsible.

Differences to the configuration manual

In contrast to the configuration manual, the operating instructions are independent of the drive system. They do not contain any data sheets or installation/dimension drawings. Information on the configuring and ordering of the motors is also not part of these instructions.

Text format features

In addition to the safety-related notices and instructions which you must read, the text in these operating instructions is formatted in the following way:

1. Handling instructions are always formatted as a numbered list. Always perform the steps in the order given.

- Lists are formatted as bulletted lists.
  - Lists on the second level are hyphenated.

Note

A Note is an important item of information about the product, handling of the product or the relevant section of the document. Notes provide you with help or further suggestions/ideas.

Target group

These operating instructions are intended for electricians, fitters, service technicians and warehouse personnel.

Technical Support

For technical support telephone numbers for different countries, go to:

http://www.siemens.com/automation/service&support

Recommended additional documents

System components	Manufacturer's manuals
Motor	• Configuration Manual • General Safety Instructions
Position measuring system	• User Manual • Operating Instructions
Brake	• Operating Instructions
Sensor module	• Manual
Drive system	• Commissioning Manual • List Manual • Function Manual

More information

Information on the following topics is available under the link:

- Ordering documentation/overview of documentation
- Additional links to download documents
- Using documentation online (find and search in manuals/information)

http://www.siemens.com/motioncontrol/docu

Please send any questions about the technical documentation (e.g. suggestions for improvement, corrections) to the following e-mail address:

docu.motioncontrol@siemens.com

Current manuals and operating instructions for motors / direct drives are available on the Internet under the following link:

http://www.siemens.com/motioncontrol/docu

Any manuals or operating instructions that you may have in printed or electronic file form could be of an older product version.

Websites of third parties

This publication contains hyperlinks to websites of third parties. Siemens does not take any responsibility for the contents of these websites or adopt any of these websites or their contents as their own, because Siemens does not control the information on these websites and is also not responsible for the contents and information provided there. Use of these websites is at the risk of the person doing so.

Internet address for products

http://www.siemens.com/motioncontrol

Standards and regulations

The product complies with the standards relating to the Low-Voltage Directive stated in the EC Declaration of Conformity.

The motor components and also the packaging comply with EC directive 2002/95/EC (RoHS).

Further notes

Besides the Danger and Warning Concept explained on the back of the cover sheet, this documentation also contains additional notes:

Note

in this document indicates important information about the product or the respective part of the documentation that is to be considered.

Safety notes 2

These safety guidelines apply for handling linear motors and their components. Please read these safety guidelines carefully to avoid accidents and/or property damage.

2.1 Residual risks

Residual risks of power drive systems

When carrying out a risk assessment of the machine in accordance with the EU Machinery Directive, the machine manufacturer must as a minimum consider the following residual risks associated with the control and drive components of a power drive system (PDS).

1. Unintentional movements of driven machine components during commissioning, operation, maintenance, and repairs caused by, for example:
   - Hardware defects and/or software errors in the sensors, controllers, actuators, and connection technology
   - Response times of the controller and drive
   - Operating and/or ambient conditions not within the scope of the specification
   - Parameterization, programming, cabling, and installation errors
   - Use of radio devices / cellular phones in the immediate vicinity of the controller
   - External influences / damage
2. Exceptional temperatures as well as emissions of light, noise, particles, or gas caused by, for example:
   - Component malfunctions
   - Software errors
   - Operating and/or ambient conditions not within the scope of the specification
   - External influences / damage
3. Hazardous shock voltages caused by, for example:
   - Component malfunctions
   - Influence of electrostatic charging
   - Induction of voltages in moving motors
   - Operating and/or ambient conditions not within the scope of the specification
   - Condensation / conductive contamination
   - External influences / damage

4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc. if they are too close.
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly.

More extensive information concerning the residual risks associated with the PDS is provided in the relevant chapters of the technical user documentation.

⚠ DANGER

It may be dangerous for people to remain in the immediate proximity of the product – especially for those with pacemakers, implants or similar – due to electric, magnetic and electromagnetic fields (EMF) occurring as a consequence of operation.

The machine/system operator and the people present near the product must observe the relevant guidelines and standards! These are, for example, in the European Economic Area (EEA) the Electromagnetic Fields Directive 2004/40/EC and the standards EN 12198-1 to 12198-3 and in the Federal Republic of Germany the Employer's Liability Insurance Association Regulations for the Prevention of Industrial Accidents BGV 11, with the relevant rule BGR 11 "Electromagnetic Fields".

Then a risk assessment must be carried out for every workplace, activities for reducing dangers and exposure for people decided upon and implemented, as well as determining and observing exposure and danger areas.

2.2 Observing and complying with safety instructions

⚠ DANGER

There is a danger of death, severe physical injury, and/or damage to property if the safety instructions are not observed and complied with.

It is essential that you observe the safety instructions in this documentation. This includes the special safety instructions in the individual sections.

Observe all warning and information plates.

Make sure that your end product satisfies all relevant standards and legal specifications. The applicable national, local, and machine-specific safety regulations and requirements must also be taken into account.

Also observe the relevant operating instructions when working on the drive system.

2.3 Handling direct drives and components

DANGER

There is danger of death, serious bodily injury and/or property damage when untrained personnel is allowed to handle direct drives and/or their components.

Only personnel who are familiar with and who observe the safety guidelines are allowed to handle direct drives and their components.

Installation, commissioning, operation and maintenance may only be performed by qualified, trained and instructed personnel. The personnel must be thoroughly familiar with the content of this guide.

All work must be performed by at least two persons.

Note

Make sure that the information about the sources of danger and the safety measures is available at all times! Keep all the descriptions and safety guidelines concerning direct drives and their components if possible!

All descriptions and safety guidelines can also be requested from your local Siemens office.

2.4 Intended use

DANGER

There is a risk of death, serious personal injury and/or serious material damage when direct drives or their components are used for a purpose for which they were not intended.

The motors are designed for industrial or commercial machines. It is prohibited to use them in areas where there is a risk of explosion (Ex-zone) unless they are designed expressly for this purpose (observe the separately enclosed additional instructions where applicable). If increased demands (e.g. touch protection) are applicable in special cases – for use in non-commercial systems – these conditions must be ensured on the machine side during installation.

Direct drives and their components may only be used for the applications specified by the manufacturer. Please contact your Siemens branch responsible if you have any questions on this matter.

The motors must be protected from dirt and contact with aggressive substances.

Special versions and design variants whose specifications vary from the motors described herein are subject to consultation with your Siemens branch.

The on-site conditions must comply with the rating plate specifications and the condition specifications contained in this documentation. Any differences regarding approvals or country-specific guidelines must be taken into account separately.

DANGER

The products included in the scope of delivery are exclusively designed for installation in a machine. Commissioning is prohibited until it has been established that the end product conforms with Directive 2006/42/EC. All safety instructions must be observed and given to the end user for his/her information.

WARNING

The motors cannot be operated directly on the supply system, but may only be operated with a suitable drive system.

2.5 Danger from strong magnetic fields

Occurrence of magnetic fields

Strong magnetic fields occur in the components of the motor that contain permanent magnets. The magnetic field strength of the motors results exclusively from the magnetic fields of the components with permanent magnets in the de-energized state. Electromagnetic fields also occur during operation.

Components with permanent magnets

⚠ CAUTION

For the linear motors described here, the permanent magnets are in the secondary section.

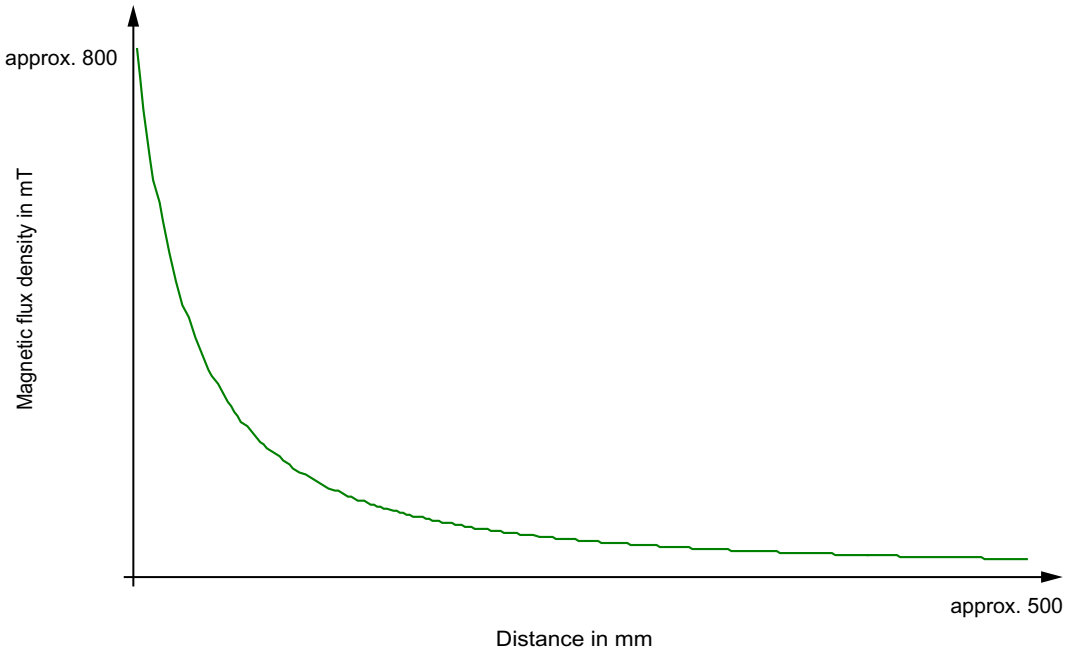


Figure 2-1 Schematic representation of the static magnetic field of a secondary section, depending on distance

Danger from strong magnetic fields

⚠ DANGER

Strong magnetic fields can pose a risk to personnel and cause damage.

With regard to the effect of strong magnetic fields on people, the work guideline BGV B 11 "Electromagnetic Fields" applies in Germany. This specifies all the requirements that must be observed in the workplace. In other countries, the relevant applicable national and local regulations and requirements must be taken into account.

People with active electrical component implants (e.g. pacemakers, insulin pumps), metal implants and magnetic or electrically conducting foreign bodies are urgently advised to avoid direct contact with components containing permanent magnets. This applies to, e.g., any work connected with assembly, maintenance or storage.

BGV B 11 specifies a limit value of 212 mT for static magnetic fields. This must be observed for distances greater than 20 mm from a secondary section track.

The requirements of BGV B 11 must also be taken into account with regard to strong magnetic fields (BGV B11 §14).

⚠ DANGER

Personnel who are exposed to magnetic fields in their daily work must maintain a distance of at least 50 mm from a secondary section track.

Personnel with pacemakers must maintain a distance of at least 500 mm from a secondary section track.

Humans have no sensory organs for picking up strong magnetic fields and have no experience with them as a rule. Therefore, the magnetic forces of attraction emanating from strong magnetic fields are often underestimated.

The magnetic forces of attraction may be several kN in the vicinity of the motor components containing permanent magnets (within a distance of less than 100 mm). – Example: Magnetic attractive forces are equivalent to a mass of several hundred kilos, which can trap a part of the body (hands, fingers, feet etc.)!

⚠ DANGER

Strong attractive forces on magnetizable materials lead to a great danger of crushing in the vicinity of components with permanent magnets (distance less than 100 mm).

Do not underestimate the strength of the attractive forces!

Do not carry any objects made of magnetizable materials (e. g. watches, steel or iron tools) and/or permanent magnets close to the motor or close to a component with permanent magnets.

For the event of accidents when working with permanent magnets, the following objects must be on hand to free clamped body parts (hands, fingers, feet etc.):

- a hammer (about 3 kg) made of solid, non-magnetizable material
- two pointed wedges (wedge angle approx. 10° to 15°) made of solid, non-magnetizable material (e.g. hard wood)

First aid in the case of accidents involving permanent magnets

- Stay calm.
- Press the emergency stop switch and, where necessary, switch off the main switch if the machine is live.
- Administer FIRST AID. Call for further help if required.
- To free jammed body parts (e.g., hands, fingers, feet), pull apart components that are clamped together.
  - To do this, use a hammer to drive a wedge into the separating rift
  - Release the jammed body parts.
- If necessary, call for an EMERGENCY DOCTOR.

⚠ WARNING

Any movement of electrically conductive materials in relation to permanent magnets leads to induced voltages. Risk of electric shock!

Movement of components with permanent magnets in relation to electrically conductive materials must be avoided.

⚠ CAUTION

Magnetic fields can lead to loss of data on magnetic or electronic data media.

Do not carry any magnetic or electronic data media with you!

2.6 Risk of electric shock

⚠ DANGER

Danger due to high leakage currents

If high leakage currents are present, more stringent requirements may apply to the PE conductor. Warning signs may also be required on the PDS. You can find more detailed information in the standard DIN EN EN 61800-5-1.

Protective measures against residual voltages

⚠ DANGER

There is a shock hazard danger due to the residual voltages at the motor terminals!

When the power supply voltage is switched-out, active parts of the motor can have a charge of more than 60 µC. In addition, at open-circuit cable ends - e.g. when a connector is withdrawn - even after the power has been disconnected, a voltage or more than 60 V can be present for 1 s. This is the reason that you must apply the appropriate measures to provide protection against residual voltages!

2.7 Attaching warning signs

Any danger areas encountered during normal operation, maintenance, and servicing must be identified by well visible warning and prohibiting signs (pictograms) in the immediate vicinity of the danger (close to the motor). The associated texts must be available in the language of the country in which the product is used.

Supplied pictograms

Primary sections

For all primary sections, warning signs are enclosed in the packaging in the form of permanent adhesive stickers. The following table shows the warning signs included with the primary sections and their meaning.

Table 2- 1 Warning signs according to BGV A8 and DIN 4844-2 included with primary sections and their meaning

Sign	Meaning	Sign	Meaning
	Warning: Hot surfaces (D-W026)		Warning: Hazardous electric voltage (D-W008)

The following safety instructions are attached at the signal port of the primary section

Table 2- 2 Safety instructions for thermal protection according to BGV A8 and DIN 4844-2 and their meaning

Sign	Meaning	Sign	Meaning
	Warning: Hazardous location (D-W000)		Observe operating instructions (D-M018)

Secondary sections

For all secondary sections, warning and prohibiting signs are enclosed in the packaging in the form of permanent adhesive stickers. These should be clearly visible and attached to the sides of the secondary section track or as close to the motor as possible.

Note

Do not attach the stickers to a secondary section or the secondary section cover. The signs will not stick permanently there.

The following tables show the warning and prohibiting signs included with the secondary sections and their meaning.

Table 2- 3 Warning signs according to BGV A8 and DIN 4844-2 included with secondary sections and their meaning

Sign	Meaning	Sign	Meaning
	Warning: Strong magnetic field (D-W013)		Warning: Hand injuries (D-W027)

Table 2- 4 Prohibiting signs according to BGV A8 and DIN 4844-2 included with secondary sections and their meaning

Sign	Meaning	Sign	Meaning
	No pacemakers (D-P011)		No metal implants (D-P016)
	No metal objects or watches (D-P020)		No magnetic or electronic data media (D-P021)

Note

The quality of the label can diminish as result of extreme environmental conditions.

Description

3

3.1 Area of application

Basic features of the motor

Motors of the 1FN3 product family are permanent-magnet synchronous linear motors with a modular cooling concept: Depending on the accuracy requirements, the motor can be optionally operated with a primary section precision cooler and/or secondary section cooling. The motors are then thermally neutral toward the machine.

The motor is delivered in components (at least primary section and secondary sections) and directly installed on the machine. Due to the series connection of primary and secondary sections, arbitrary motor forces and straight traversing paths of various lengths can be achieved.

Please take note of national and international license terms when operating direct motors so that no patent rights are violated.

Overview of the connection variants

Peak load and continuous load motor
Two fixed cables with/without connector

Peak load and continuous load motor
Terminal panel for two cables

Peak load motor
Terminal panel for one cable
or
one fixed cable with/without connector

Area of application

Peak load motors

Combined with a drive system with digitally controlled drive system, the 1FN3 peak load motors are well-suited as direct drives for linear motion, e.g. for:

- Highly dynamic and flexible machine tools
- Laser machining
- Handling

Continuous load motors

Combined with a drive system with digital closed-loop control, continuous load motors in the 1FN3 product family are well-suited as direct drives for linear motion, e.g. for:

- Oscillating motion (e.g. non-circular machining)
- Applications with high process forces (e.g. grinding, turning...)
- Vertical axes without weight compensation, quills
- Handling, Cartesian robots

3.2 Rating plate

Supplied rating plates

A rating plate is attached to each primary section of a 1FN3 motor. Additionally, a second rating plate that the customer can attach to the machine in which the motor is installed is included in the delivery.

Note

The rating plates should not be misused! If a rating plate is removed from the motor or machine, it must be made unusable.

Data on the rating plate

The following data is on the rating plate:

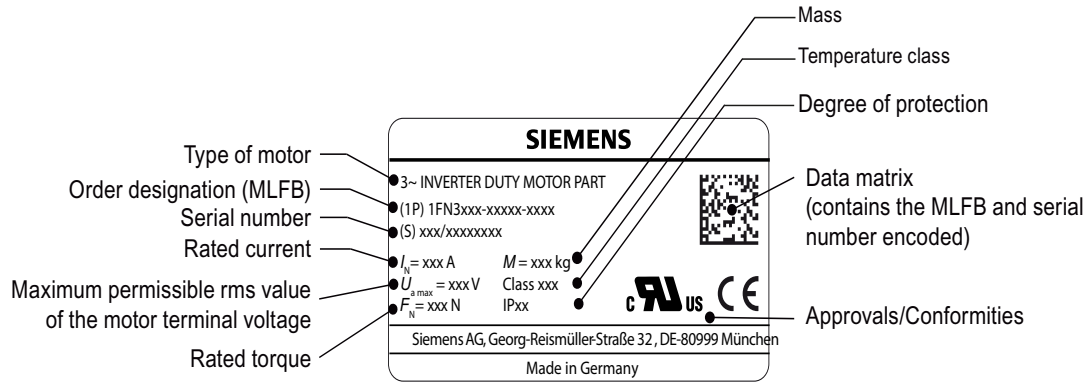


Figure 3-1 Data on the rating plate

3.3 Layout

3.3.1 Motor components

Motor components

Motors of the 1FN3 product family consist of the following components:

- Primary section:
  - Basic component of the linear motor
  - With 3-phase winding
  - Integrated main cooler to dissipate the heat loss
- Precision cooler (optional):
  - Additional cooler to minimize the heat transfer to the machine in accordance with the Thermo-Sandwich® principle
  - Recommended for applications with high precision requirements
- Secondary sections:
  - Mounted side-by-side these form the reactive part of the motor
  - Consist of a steel base with attached permanent magnets
  - The casing provides a large degree of protection against corrosion and external effects
- Secondary section cover (optional):
  - Mechanical protection for secondary sections
  - Stainless steel plate that can be magnetized (thickness d = 0.4 mm)
  - Adheres to secondary sections
  - Can be removed without tools if worn
  - Available as a continuous band or as a segmented cover with fixed lengths

- Cooling sections with plug-in connector/nipple (optional):
  - Secondary cooling component
  - Aluminum rail sections with integrated cooling channels
  - Are placed under the secondary sections when high machine precision is required
- Secondary section end pieces (optional):
  - Secondary cooling component
  - Used to hold down the integrated secondary section cover
  - Available in different versions

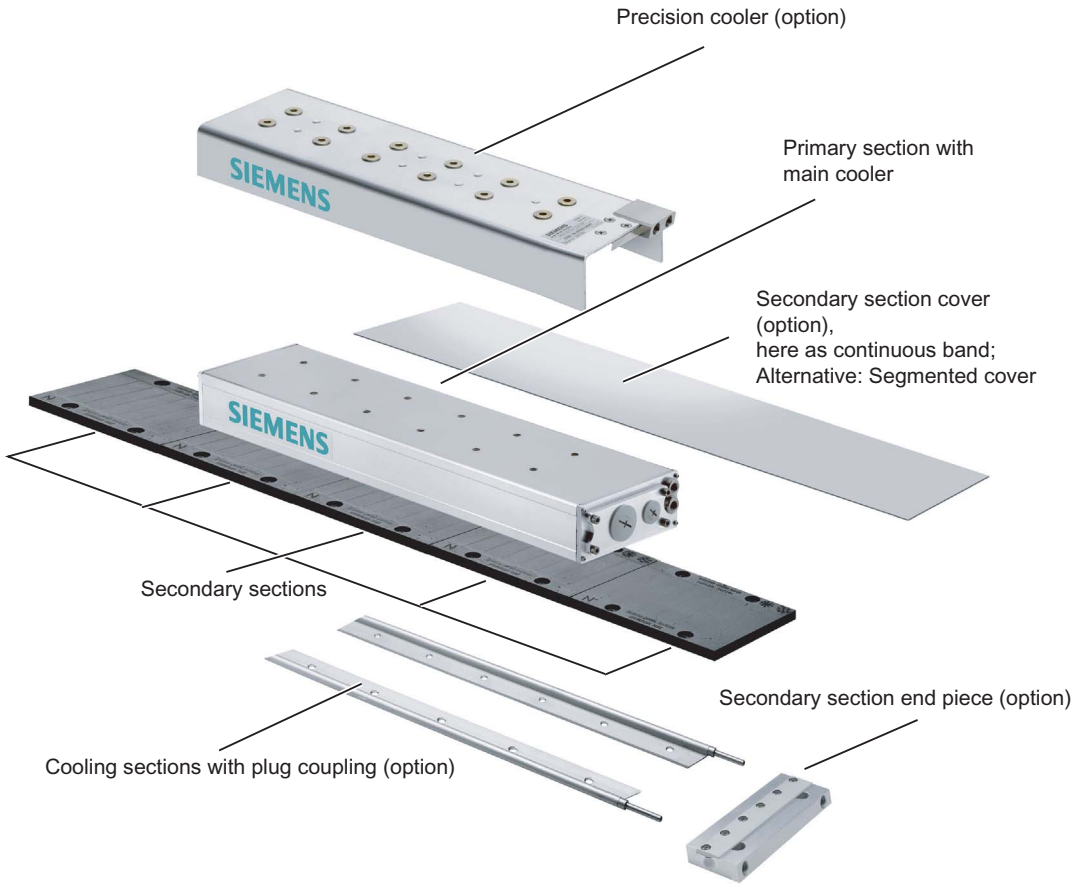

Precision cooler (option)
Primary section with main cooler
Secondary section cover (option), here as continuous band; Alternative: Segmented cover
Secondary sections
Secondary section end piece (option)
Cooling sections with plug coupling (option)

Figure 3-2 Components of a 1FN3 linear motor

3.3.2 Degrees of protection

Primary section

The primary sections meet the requirements for IP65 degree of protection in accordance with EN 60529 and EN 60034-5.

Secondary sections

The secondary sections are protected against corrosion to a large degree via structural measures.

Make sure that the secondary sections are kept free of chips. Suitable covers should be provided for this purpose. It can be assumed that ferromagnetic particles are no longer attracted as of a distance of 150 mm from the surface of the secondary section.

The use of abrasive or aggressive substances (such as acids) must be avoided.

3.3.3 Ambient conditions

Ambient conditions for long-term storage, transport, and use in fixed locations

Based on DIN EN 60721-3-1 (for long-term storage), DIN EN 60721-3-2 (for transport), and DIN EN 60721-3-3 (for use in fixed, weather-protected locations)

Table 3- 1 Climatic ambient conditions

Lower air temperature limit:	- 5 °C (deviates from 3K3)
Upper air temperature limit:	+ 40 °C
Lower relative humidity limit:	5%
Upper relative humidity limit:	85%
Rate of temperature fluctuations:	Max 0.5 K/min
Condensation:	Not permissible
Formation of ice:	Not permissible
Long-term storage:	Class 1K3 and class 1Z1 have a different upper relative humidity
Transport:	Class 2K2
Fixed location:	Class 3K3

Storage, transport and operation permissible only in locations that are fully protected against the weather (in halls or rooms).

Table 3- 2 Biological ambient conditions

Long-term storage:	Class 1B1
Transport:	Class 2B1
Fixed location:	Class 3B1

Table 3- 3 Chemical ambient conditions

Long-term storage:	Class 1C1
Transport:	Class 2C1
Fixed location:	Class 3C2 Different to class 3C2: Operating site in the immediate vicinity of industrial plants with chemical emissions

Table 3- 4 Mechanically active ambient conditions

Long-term storage:	Class 1S2
Transport:	Class 2S2
Fixed location:	Class 3S1

Table 3- 5 Mechanical ambient conditions

Long-term storage:	Class 1M2
Transport:	Class 2M2
Fixed location:	Class 3M3

3.3.4 Cooling

Note

Throughout this document, "cooling" refers to water cooling of the motor.

Necessity of a cooling system

During operation, the motor heats up. To maintain the highest possible power density, water cooling is necessary.

Components

The cooling system of the 1FN3 motors may consist of a variety of components:

- Primary section main cooler
- Primary section precision cooler
- Secondary section cooling

These components are structurally separated for motors of the 1FN3 product family. They enable the configuration of a cooling system according to the Thermo-Sandwich® principle.

Structure of a cooling system according to the Thermo-Sandwich® principle.

In the Thermo-Sandwich® principle, components of the cooling system are layered on top of each other. All components are separated by an insulating layer (see the image below). The thermal flow from the primary section into the machine assembly is restricted by this multi-layer cooling design: Heat is dissipated in each component of the cooling system. Therefore, the residual amount of heat that ultimately reaches the machine is very low.

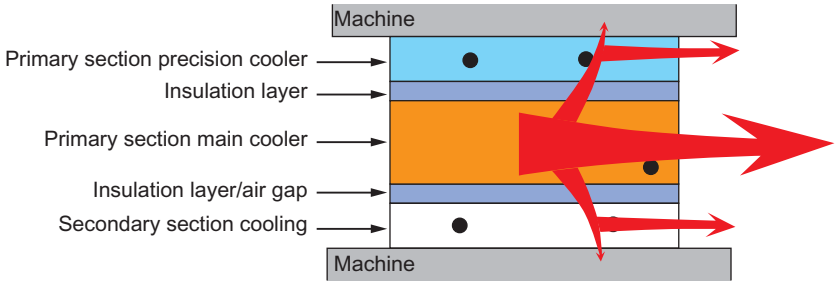


Figure 3-3 Schematic representation of the Thermo-Sandwich® principle

Functions of the cooling components

Primary section main cooler

The primary section main cooler is directly built into the primary section and cools it. Under rated conditions, it removes between 85% and 90% of the arising heat. This suffices to achieve the rating data listed in the data sheets.

The primary section main cooler has no effect on the heat insulation of the motor from the machine.

Primary section precision cooler

The primary section precision cooler dissipates residual heat (2% to 10% of the entire power loss) from the primary section. The temperature increase of the outer surface of the primary section precision cooler is thus maintained in a very small fluctuation range in comparison with the intake temperature of the primary section precision cooler. Together with the secondary section cooling system, the primary section precision cooler prevents thermal transfer into the attached mechanical assembly, thereby ensuring that the behavior of the motor in the machine remains almost 100% thermally neutral.

Secondary section cooling system

The secondary section cooling system also dissipates residual heat of the motor. The heat dissipated by the secondary section cooling system amounts to about 5% to 8% of the total power loss of the motor under rated conditions.

Details of the thermal encapsulation

1FN3 motors are cooled according to the Thermo-Sandwich® principle. The following figure shows details of the thermal encapsulation.

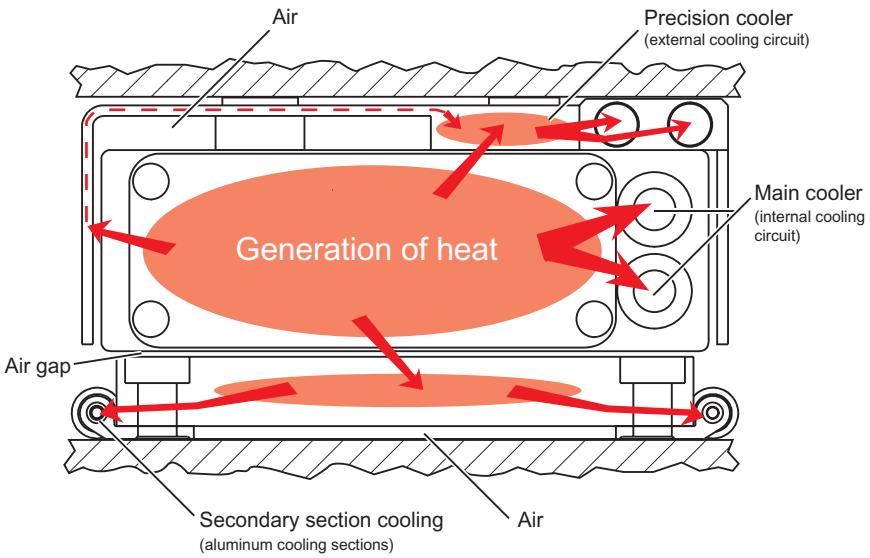


Figure 3-4 Thermal encapsulation of 1FN3 motors

Cooling of the primary section / primary section main cooler

As standard, the motor is cooled using water and an anticorrosive agent at an intake temperature of T_{INT} = 35° C. If this temperature is changed, the continuous force of the motor changes with respect to the table value F_N. Make sure that condensation cannot occur with a change in the intake temperature.

Thermal insulation of the primary section / primary section precision cooler

The primary section is insulated on the lower side by the air gap. On the top side, the (optional) primary section precision cooler shields the surrounding area from excessively high motor temperatures. Thermo-insulators on the screwed connections and the air chamber located in between reduce heat transfer from the primary section. The lateral radiation panels of the primary section precision cooler also form air filled spaces and insulate the primary section laterally from the machine. Under rated conditions, the temperature increase of the outer surface of the primary section precision cooler compared to the intake temperature is a maximum of 4 K. If the primary section precision cooler is not used, the temperatures on the surface of the motor may exceed 100° C.

Thermal insulation of the secondary section / secondary section cooling system

The secondary section is cooled by a cooling circuit, which as standard consists of cooling sections and two combi-distributors as secondary section end pieces.

The secondary sections must be cooled in the case of:

- Applications with high heat loss entries in the secondary sections
- Applications whose machine base does not guarantee cooling via the secondary section contact surface

Otherwise, secondary section cooling is optional.

⚠ CAUTION
High temperatures can lead to the demagnetization of the permanent magnets!
The secondary sections must not exceed a temperature of 70 °C!

For 1FN3600 and 1FN3900 motors, secondary section cooling is imperative for the proper function of the motors as the large amount of heat transferred from the primary section to the secondary sections cannot be dissipated to the machine bed via the secondary sections' contact surfaces.

Secondary section cooling components

Heatsink profiles and secondary sections end pieces are generally required for cooling the secondary sections of motors in the 1FN3 product family.

Heatsink profiles

The heatsink profiles are laid between the machine base and the secondary sections and together with these screwed to the machine base. The following two figures show the resulting cooling system without secondary section end pieces. The blue dotted lines indicate the cooling medium flow.

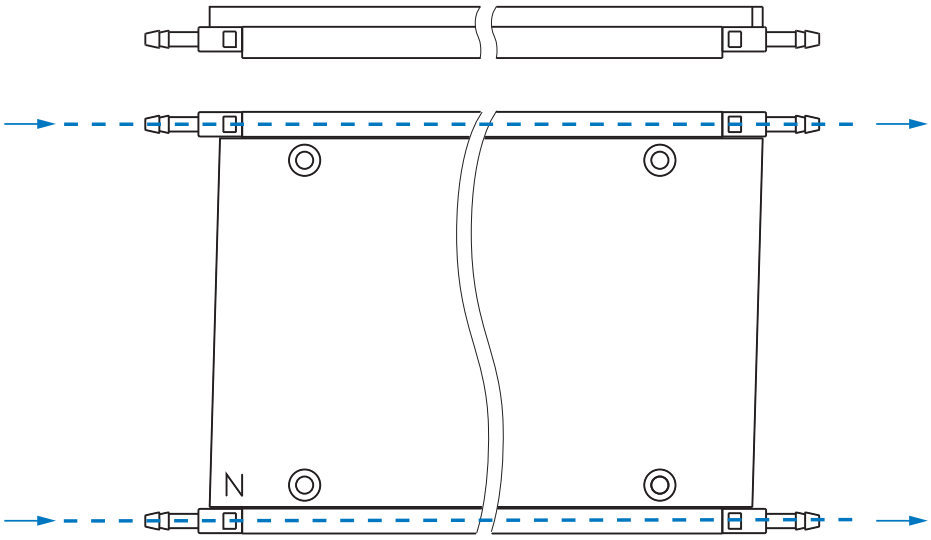


Figure 3-5 Secondary section cooling consisting of heatsink profiles with hose connector nipples for 1FN3050…3450 motor models (side and top view)

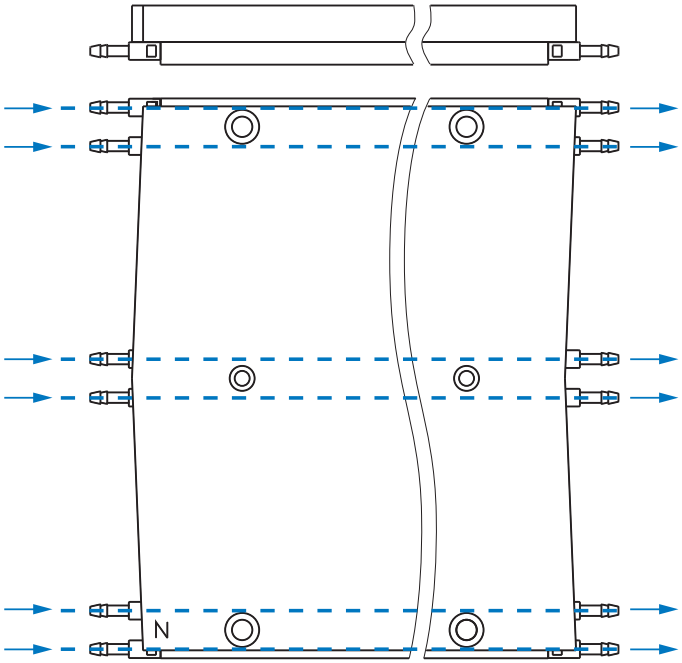


Figure 3-6 Secondary section cooling consisting of heatsink profiles with hose connector nipples for 1FN3600…3900 motor models (side and top view)

As of model 3600 three heatsink profiles with a total of six cooling channels are used. The lateral profiles protrude just a little beyond the secondary section. The middle (additional) cooling section is attached by the line of screws in the center of the secondary sections.

The surfaces of the cooling sections are thermally optimized. The heat is transferred to the contact area of the secondary section track and from there to the cooling channel. Toward the machine structure, however, the contact area is small, so that the heat transfer is kept at a minimum.

The cooling sections are available in lengths up to 3 m.

Secondary section end pieces

The following secondary section end pieces at the start and end of the secondary section track close the cooling circuit and facilitate the cooling medium connection through uniform connectors:

- Combi distributor
- Combi adapter / combi end piece

As standard, combi distributors are used as secondary section end pieces. These are available for all models. Combi adapters / combi end pieces can be used as an alternative for 1FN3050…450 models. Cover band end pieces are not directly involved in the cooling of the secondary sections.

The following figures show the secondary section cooling with different secondary section end piece models.

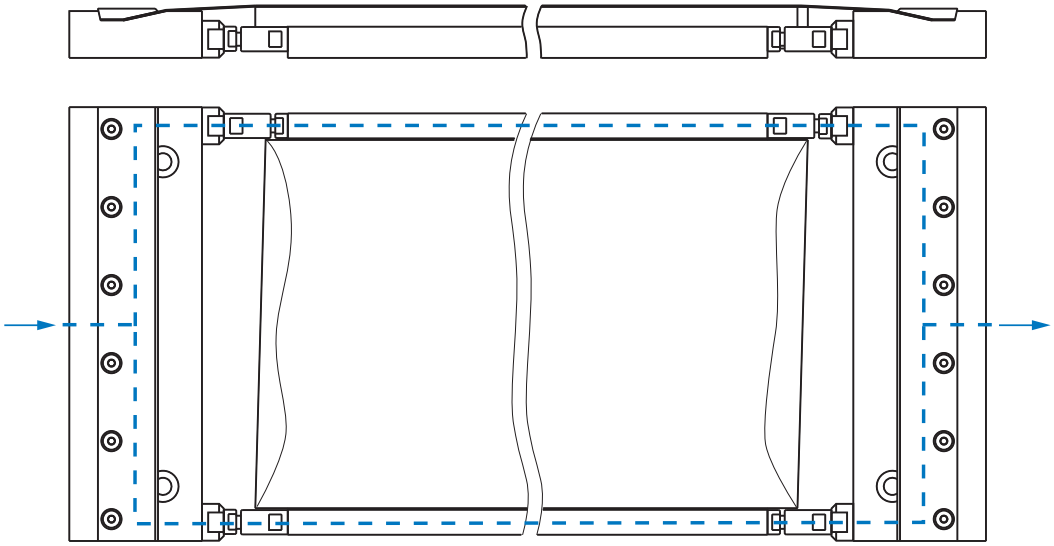


Figure 3-7 Secondary section cooling for 1FN3050...1FN3450 motor models with combi distributors (side and top view)

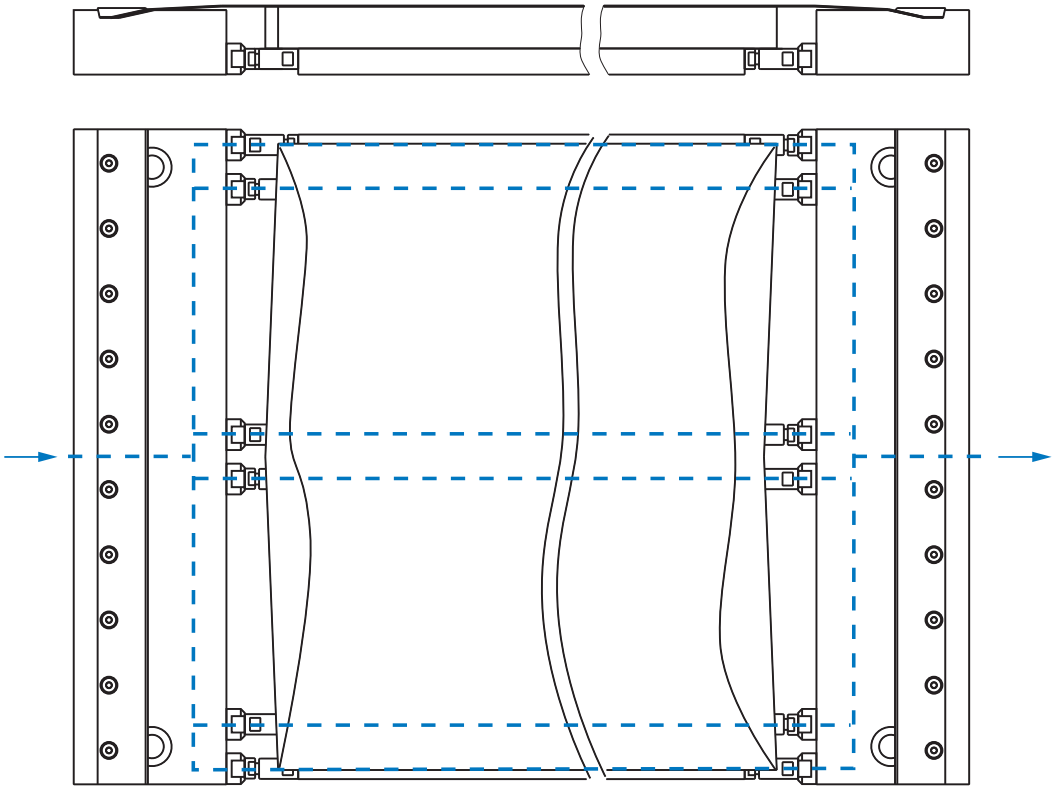


Figure 3-8 Secondary section cooling for 1FN3600 and 1FN3900 motor models with combi distributors (side and top view)

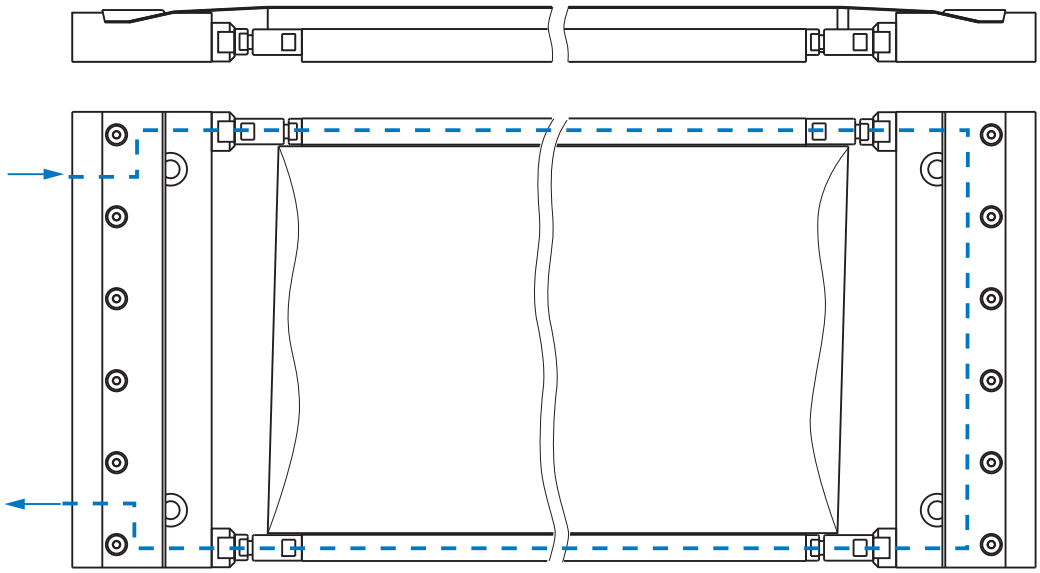


Figure 3-9 Secondary section cooling for 1FN3050...1FN3450 motor models with combi adapter and combi end piece (side and top view)

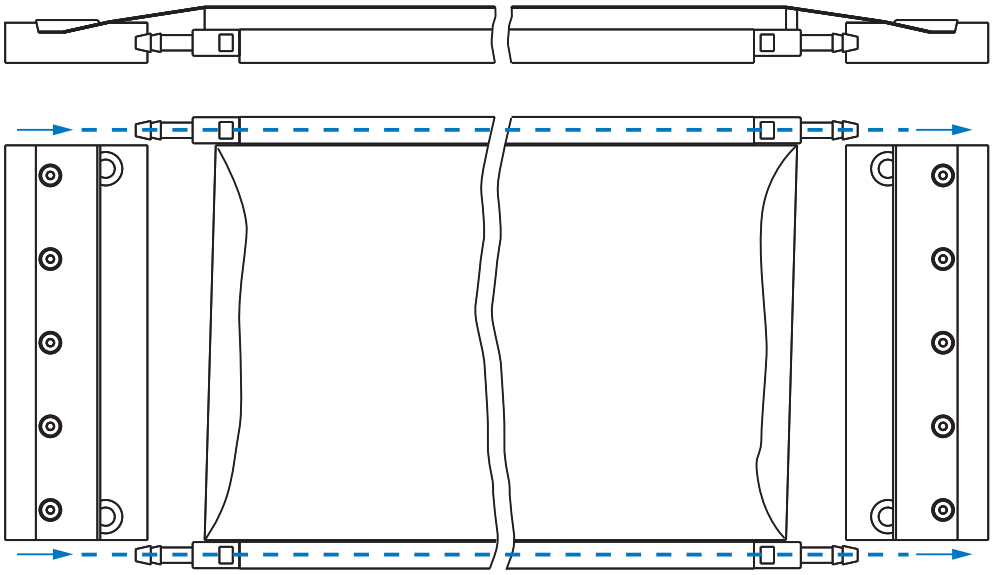


Figure 3-10 Secondary section cooling consisting of cooling sections with hose connector nipple and cover band end pieces on both sides for all 1FN3050…1FN3450 motor models (side and top view)

Note

Due to the high pressure drop, secondary section cooling with combi adapter / combi end piece can only be used for short traversing distances – up to a length of approximately 2 m. The pressure drop must be checked for the entire cooling system!

Use of the secondary section end pieces

On the one hand, the secondary section end pieces are used to connect the cooling. Combi distributors and combi adapters / combi end pieces at the start and end of the secondary section track close the cooling circuit and facilitate the cooling medium connection through uniform connectors.

On the other hand, they are needed to fix the integrated secondary section cover by means of a wedge which closes the cover flush with the surface, see following figure.

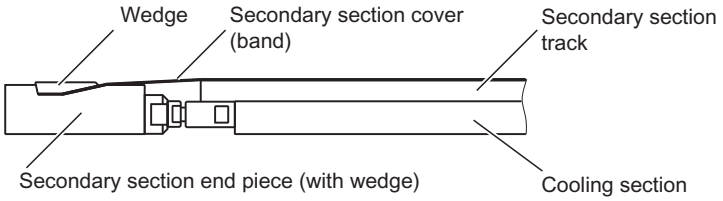


Figure 3-11 Secondary section end piece (side view)

As standard, combi distributors are used as secondary section end pieces. These are available for all models. Combi adapters / combi end pieces or cover band end pieces can be used as an alternative for 1FN3050…450 models.

Overview of the variants

In summary, the following secondary section end piece variants are available:

- Combi distributor:
  - Standard solution for the use of secondary section end pieces
  - Available for all models
  - Attaches the secondary section cover (band) to the start and end of the secondary section track
  - Implements the connection and parallel distribution of the cooling medium to two (1FN3050…450) or three (1FN3600…900) cooling sections at the start of the secondary section track
  - Implements the convergence of the cooling medium flow and cooling medium discharge connection at the end of the secondary section track
- Combi adapter / combi end piece:
  - Available for 1FN3050…1FN3450 models
  - Attaches the secondary section cover (band) to the start and end of the secondary section track
  - Implements the cooling medium connection and cooling medium return: The cooling medium intake and return connections are located on the combi adapter. The combi end piece is required for the cooling medium return at the other end of the secondary section track.
- Cover end piece:
  - Available for 1FN3050…1FN3450 models
  - Attaches the secondary section cover (band) to the start and end of the secondary section track

3.3.5 Temperature monitoring and thermal motor protection

Temperature monitoring circuits Temp-F and Temp-S

The motors are supplied with two temperature monitoring circuits: Temp-F and Temp-S. Temp-F is used to monitor and evaluate the temperature characteristic in the motor. Temp-S is used to activate the motor protection when the motor windings become too warm.

Both circuits are independent of each other. They are generally evaluated via the drive system.

Temp-F (KTY 84 Sensor)

The *temperature monitoring circuit* Temp-F consists of a KTY 84 temperature sensor located at the coils. Under certain circumstances – especially with varying current feed of the individual phases – this can result in the maximum temperature of the three phase windings not being measured. An evaluation of Temp-F for motor protection is thus not permissible. Temp-F is used rather to observe the temperature and if necessary to warn that the drive is being switched off due to a response from Temp-S.

Temp-S (PTC element)

The *overtemperature shutdown circuit* consists of thermistor temperature sensors (PTC elements). There is a thermistor temperature sensor for monitoring the motor winding in each of the three phase-windings (U, V and W). This ensures overload protection, even if the current feed is uneven in a primary section's individual phases or if several primary sections are being loaded differently. The PTC elements are connected in series.

Note

The drive control reaction time may not exceed one second, from the response of the PTC element (Temp-S) to the disconnection of the power supply (pulse inhibit in the drive control).

The total reaction time from the event occurrence to the shutdown must not exceed two seconds and must be guaranteed irrespective of the evaluation.

Technical properties of the KTY 84

The KTY 84 produces a resistance/temperature characteristic curve that is progressive and approximately linear (see the image below). In addition, the KTY 84 has a low thermal capacity and provides good thermal contact with the motor winding.

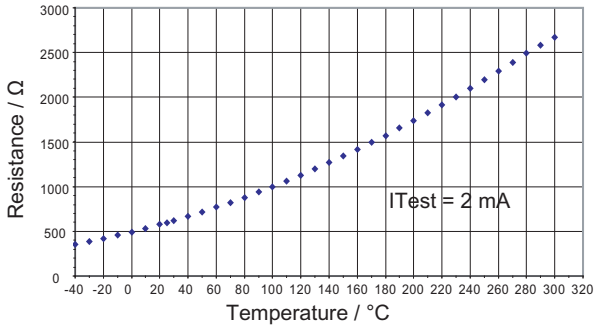


Figure 3-12 Characteristic curve of a KTY 84

Technical data:

- Resistance when cold (20 °C): approx. 580 Ω
- Resistance when hot (100 °C): approx. 1000 Ω

Technical properties of PTC elements

Each PTC element displays a sudden increase in resistance in the region of the rated response temperature ϑ_{NAT}, see following figure. This gives it a quasi-switching characteristic. Due to low thermal capacity and good thermal contact between the PTC element and the motor winding, the sensors - and therefore the system - are able to react quickly to inadmissibly high temperatures in the winding.

The PTC elements of the triplet are connected in series. The characteristics correspond with DIN EN 60947-8, DIN 44081, and DIN 44082.

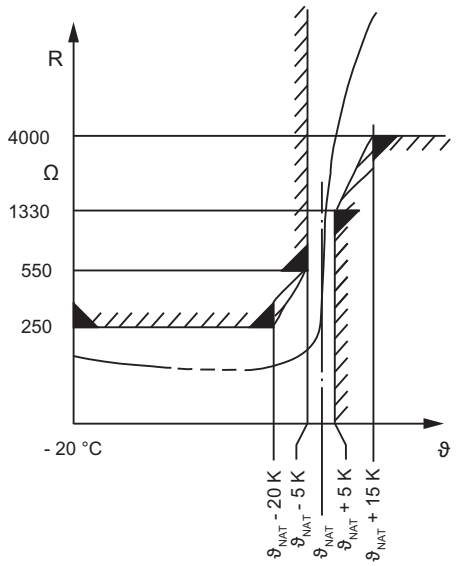


Figure 3-13 Typical characteristic curve of a PTC element; source: DIN 44081 / DIN 44082

Technical data:

According to DIN 44081 / DIN 44082, the resistance at the triplet is

- maximum 3x250 Ω = 750 Ω at T > -20 °C and T < ϑ_{NAT} - 20 K
- maximum 3x550 Ω = 1650 Ω at T < ϑ_{NAT} - 5 K
- minimum 3x1330 Ω = 3990 Ω at T < ϑ_{NAT} + 5 K
- minimum 3x4000 Ω = 12000 Ω at T < ϑ_{NAT} + 15 K

Note

The PTC elements are pure sensors and can only disconnect the motor via an external evaluation.

Preparations for use

4

Note

Always follow the safety instructions and notices in these operating instructions.

4.1 Shipment and packaging

Checking the delivery for completeness

When you take receipt of the delivery, please check immediately whether the items delivered are in accordance with the accompanying documents.

- Report any apparent transport damage to the delivery agent immediately.
- Report any apparent defects / missing components to the appropriate Siemens office immediately.

Siemens will not accept any claims relating to items missing from the delivery and which are submitted at a later date.

Supplied pictograms

Primary sections

For all primary sections, warning signs are enclosed in the packaging in the form of permanent adhesive stickers. The following table shows the warning signs included with the primary sections and their meaning.

Table 4- 1 Warning signs according to BGV A8 and DIN 4844-2 included with primary sections and their meaning

Sign	Meaning	Sign	Meaning
	Warning: Hot surfaces (D-W026)		Warning: Hazardous electric voltage (D-W008)

The following safety instructions are attached at the signal port of the primary section

Table 4- 2 Safety instructions for thermal protection according to BGV A8 and DIN 4844-2 and their meaning

Sign	Meaning	Sign	Meaning
	Warning: Hazardous location (D-W000)		Observe operating instructions (D-M018)

Secondary sections

For all secondary sections, warning and prohibiting signs are enclosed in the packaging in the form of permanent adhesive stickers. These should be clearly visible and attached to the sides of the secondary section track or as close to the motor as possible.

Note

Do not attach the stickers to a secondary section or the secondary section cover. The signs will not stick permanently there.

The following tables show the warning and prohibiting signs included with the secondary sections and their meaning.

Table 4- 3 Warning signs according to BGV A8 and DIN 4844-2 included with secondary sections and their meaning

Sign	Meaning	Sign	Meaning
	Warning: Strong magnetic field (D-W013)		Warning: Hand injuries (D-W027)

Table 4- 4 Prohibiting signs according to BGV A8 and DIN 4844-2 included with secondary sections and their meaning

Sign	Meaning	Sign	Meaning
	No pacemakers (D-P011)		No metal implants (D-P016)
	No metal objects or watches (D-P020)		No magnetic or electronic data media (D-P021)

Note

The quality of the label can diminish as result of extreme environmental conditions.

Dimensions of the primary section packaging

Motors - MLFB	Dimensions L x W x H:
1FN3050 - 1xxx0 - 0xA1 to 1FN3100 - 2xxx0 - 0xA1	315 x 225 x 70
1FN3100 - 3xxx0 - 0xA1 to 1FN3100 - 5xxx0 - 0xA1	687 x 240 x 101
1FN3150 - 1xxx0 - 0xA1 to 1FN3150 - 2xxx0 - 0xA1	315 x 225 x 70
1FN3150 - 3xxx0 - 0xA1 to 1FN3300 - 3xxx0 - 0xA1	687 x 240 x 101
1FN3300 - 4xxx0 - 0xA1	1120 x 303 x 140
1FN3450 - 2xxx0 - 0xA1 to 1FN3450 - 3xxx0 - 0xA1	700 x 303 x 140

Motors - MLFB	Dimensions L x W x H:
1FN3450 - 4xxx0 - 0xA1	1120 x 303 x 140
1FN3600 - 2xxx0 - 0xA1 to 1FN3600 - 4xxx0 - 0xA1	845 x 423 x 125

Dimensions of the secondary section packaging

Motors - MLFB	Dimensions L x W x H:
1FN3050 - 1xxx0 - 0xA1 to 1FN3150 - 5xxx0 - 0xA1	202 x 202 x 37
1FN3300 - 1xxx0 - 0xA1 to 1FN3900 - 4xxx0 - 0xA1	402 x 272 x 57

4.2 Transport and storage

4.2.1 Safety instructions

UN number 2807 is allocated to permit magnets as hazardous item.

⚠ DANGER

Improper storage and/or transport can cause death, serious bodily injury and/or property damage.

Never store or transport unpacked motor components, even within your own premises! Only use undamaged original packaging!

Take into account the maximum loads that personnel can lift and carry. The motors and their components can weigh more than 13 kg!

When transporting machines or machine parts with pre-assembled motors, protect the components from moving unintentionally!

IATA regulations must be observed when components are transported by air.

The storage locations of components with permanent magnets must be marked with the appropriate warning signs (pictograms).

Note the warnings on the packaging.

Wear safety shoes and work gloves.

The packaging of the direct drives and their components provides reliable protection during transport and storage especially against the strong magnetic forces of components with permanent magnets.

Note

Keep the packaging of components with permanent magnets where possible!

When reusing the original packaging do not cover safety instructions that are possibly present. When required, use transparent adhesive tape for the packaging.

Original packaging can also be requested from your local Siemens office.

When shipping products that contain permanent magnets by sea or road, no additional packaging measures are required.

4.2.2 Packaging specifications for air transportation

When transporting products containing permanent magnets by air, the maximum permissible magnetic field strengths specified by the appropriate IATA Packing Instruction must not be exceeded. Special measures may be required so that these products can be shipped. Above a certain magnetic field strength, shipping requires that you notify the relevant authorities and appropriately label the products.

Note

The magnetic field strengths listed in the following always refer to values for the DC magnetic field specified in the IATA packaging instruction 953, which has been in force since January 1, 2011. If the values change, then we will take this into account in the next edition.

Products whose highest field strength exceeds 0.418 A/m, as determined at a distance of 4.6 m from the product, require shipping authorization. This product will only be shipped with previous authorization from the responsible national body of the country from where the product is being shipped and the country where the airfreight company is based. Special measures need to be taken to enable the product to be shipped.

When shipping products whose highest field strength is equal to or greater than 0.418 A/m, as determined at a distance of 2.1 m from the product, you have a duty to notify the relevant authorities and appropriately label the product.

When shipping products whose highest field strength is less than 0.418 A/m, as determined at a distance of 2.1 m from the product, you do not have to notify the relevant authorities and you do not have to label the product.

- To achieve mutual optimal weakening of the magnetic fields (magnetic interference fields) the original and individual packaging of two secondary sections must always be stacked on one another in pairs, alternating according to the following diagram. In each case, edge A-B of the lower individual package must be placed on the edge C-D of the upper individual package.

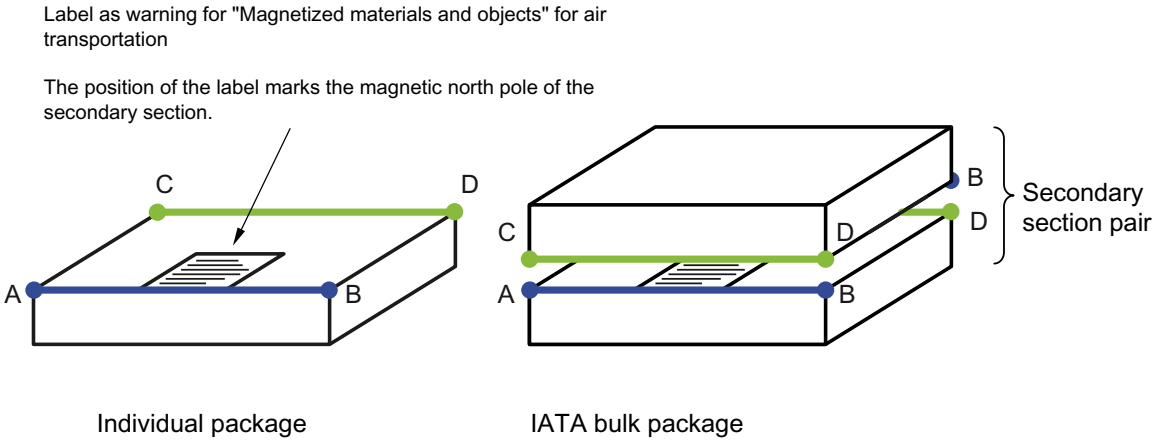


Figure 4-1 Packing for secondary sections and correct stacking

Note

The precondition for correctly stacking two secondary sections is an offset within a secondary section pair of less than 1 cm, which must be guaranteed for the complete duration of the air transport. To achieve this, fix the original individual packaging, e.g. using adhesive packaging tape. When required, use transparent adhesive packaging tape in order not to cover any safety instructions.

If the individual packages with the secondary sections are not stacked pairwise alternating on top of one another, the magnetic fields strengthen one another. If the offset within a secondary section pair is larger than 1 cm during the complete duration of the air transport, then the magnetic fields also strengthen one another.

- In bulk packaging, secondary section pairs (each pair stacked alternating, according to the diagram "Packaging for secondary sections and correct stacking") can be arranged as required.

4.2.2.1 IATA regulations for 1FN3 secondary sections

Table 4- 5 Packaging specifications for 1FN3xxx-xSxxx-xxxx secondary sections

	Not subject to notification and labeling requirements	Subject to notification and labeling requirements	Subject to authorization
A single secondary section is packaged in its original individual packaging		X	
Two secondary sections each are packaged in the original individual packaging and correctly stacked in pairs	X [2)]		
Secondary sections are packaged in the original individual packaging and cab e arbitrarily arranged			X [1)]

[1)] If the secondary section is also packed in a ferromagnetic sheet metal case in addition to the original individual packaging, e.g. manufactured out of iron with a thickness of greater than 0.5 mm, then when shipping, you only have to notify the relevant authorities and attach appropriate labels.

[2)] If an offset within a secondary section pair of less than 1 cm cannot be guaranteed for the duration of the complete air transport, then for transportation you have to notify the relevant authorities and attach appropriate labels.

Example 1

Original individual packages with secondary section pairs with the order designation 1FN3xxx-xSxxx-xxxx are correctly stacked in new packaging (bulk packaging). The shipment is not subject to notification and labeling requirements

Example 2

A maximum of one additional original individual packaging with one secondary section may be added to the new (bulk) packaging from example 1. This individual secondary section can be arbitrarily aligned, a sheet metal case to provide additional shielding is not required. The shipment of the complete new package is then subject to notification and labeling requirements.

4.2.3 Ambient conditions

Ambient conditions for long-term storage, transport, and use in fixed locations

Based on DIN EN 60721-3-1 (for long-term storage), DIN EN 60721-3-2 (for transport), and DIN EN 60721-3-3 (for use in fixed, weather-protected locations)

Table 4- 6 Climatic ambient conditions

Lower air temperature limit:	- 5 °C (deviates from 3K3)
Upper air temperature limit:	+ 40 °C
Lower relative humidity limit:	5%
Upper relative humidity limit:	85%
Rate of temperature fluctuations:	Max 0.5 K/min
Condensation:	Not permissible
Formation of ice:	Not permissible
Long-term storage:	Class 1K3 and class 1Z1 have a different upper relative humidity
Transport:	Class 2K2
Fixed location:	Class 3K3

Storage, transport and operation permissible only in locations that are fully protected against the weather (in halls or rooms).

Table 4- 7 Biological ambient conditions

Long-term storage:	Class 1B1
Transport:	Class 2B1
Fixed location:	Class 3B1

Table 4- 8 Chemical ambient conditions

Long-term storage:	Class 1C1
Transport:	Class 2C1
Fixed location:	Class 3C2 Different to class 3C2: Operating site in the immediate vicinity of industrial plants with chemical emissions

Table 4- 9 Mechanically active ambient conditions

Long-term storage:	Class 1S2
Transport:	Class 2S2
Fixed location:	Class 3S1

Table 4- 10 Mechanical ambient conditions

Long-term storage:	Class 1M2
Transport:	Class 2M2
Fixed location:	Class 3M3

4.2.4 Storage

The motors can be stored for up to two years under the following conditions:

Storing indoors

- Apply a preservation agent (e.g. Tectyl) to bare external components if this has not already been carried out in the factory.
- Store the motors as described in Section "Ambient conditions". The storeroom must be:
  - Dry, free of dust and not subject to vibration
  - Well ventilated
  - Provide protection against extreme weather conditions
  - Free of aggressive gases
- Protect the motor against shocks and humidity.
- Make sure that the motor is covered properly.

Protection against humidity

If a dry storage area is not available, then take the following precautions:

- Wrap the motor in humidity-absorbent material and then wrap it in film so that it is air tight.
- Include several bags of desiccant in the seal-tight packaging. Check the desiccant and replace as required.
- Place a humidity meter in the seal-tight packaging to indicate the level of air humidity inside it in four steps.
- Inspect the motor on a regular basis.

Protecting the cooling system for motors with integrated cooling

Before you store the motor after use:

- Empty the cooling channels
- Blow air through to completely empty them and
- Seal them

Assembling 5

5.1 Safety guidelines for the installation

⚠ DANGER

When installing direct drives, you may have to work near unpacked components with permanent magnets. The resulting danger from strong magnetic fields is, therefore, particularly high.

Only remove the packaging from the motor components immediately prior to installation.

Never simultaneously unpack several components that contain permanent magnets.

Immediately assemble components that contain permanent magnets.

Never place metals on magnetic surfaces and vice versa!

Never use magnetizable tools! If these tools are required, they must be held firmly with both hands and moved slowly toward the direct drive.

All work must be performed by two persons!

Prevent unintentional movement of pre-installed direct drives!

Only carry out work on the motor when it is de-energized and isolated from the power supply! Risk of electric shock!

⚠ WARNING

Sharp edges can cause cuts.

Wear protective gloves!

⚠ WARNING

Falling objects can injure feet.

Wear safety shoes!

⚠ DANGER

Defective connecting cables can cause an electric shock and/or material damage (e.g. by fire).

When installing the motor, make sure that the connecting cables

- are not damaged,
- are not under tension,
- cannot be caught up in moving parts,
- and that the minimum bending radius is adhered to.

It is not permissible to hold or pull the motor using the cables!

5.2 Procedure

The installation of a linear motor is divided into the following steps:

1. Checking the mounting dimensions before the installation of the motors
2. Cleaning of the attachment surfaces of motor parts and the machine
3. Installation of primary sections, secondary sections and components
4. Checking the motor installation

5.3 Checking the mounting dimensions

Basics

For the observance of the electrical and system-technical properties of the motor, only the mounting dimensions and not the measurable air gap are decisive. The mounting dimensions must lie within the specified tolerances over the complete traversing distance.

Checking

The mounting dimensions can be checked before installing the motor, e.g. using final dimensions and feeler gauges.

Installation dimensions for the motor installation

The following figure shows the installation dimensions for the motor installation. The associated values are specified in the following table. In addition, the rated air gap – the geometric distance between primary section and secondary section track – with or without secondary section cover is specified in this table.

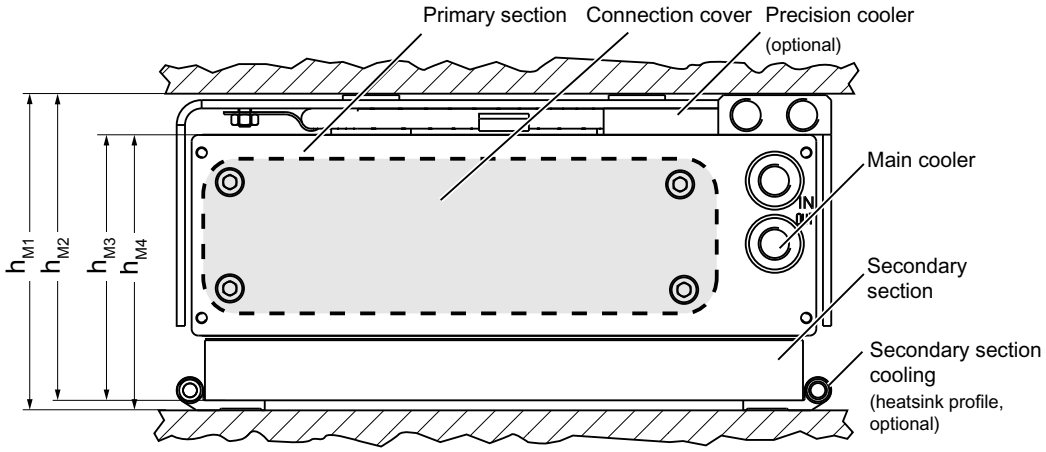


Figure 5-1 Installation dimensions for the motor installation

Peak load motor: Installation dimensions

Table 5- 1 Dimensions for the air gap and installation dimensions for installing the motor, according to the figure above

	Rated air gap with secondary section cover	Rated air gap without secondary section cover		Installation dimension with precision cooler and with secon-dary section cooler	Installation dimension with precision cooler and without secondary section cooler	Installation dimension without precision cooler and without secondary section cooler	Installation dimension without precision cooler and with secon-dary section cooler	Tolerance of the installation dimensions
1FN3..-xW	[mm]	[mm]		h_{M1} [mm]	h_{M2} [mm]	h_{M3} [mm]	h_{M4} [mm]	[mm]
1FN3050 1FN3100	0.9	1.3		63.4	60.4	48.5	51.1	± 0.3
1FN3150	0.9	1.3		65.4	62.4	50.5	53.5	± 0.3
1FN3300	0.9	1.3		79.0	76.0	64.1	67.1	± 0.3
1FN3450	0.9	1.3		81.0	78.0	66.1	69.1	± 0.3
1FN3600	0.9	1.3		86.0	--	--	74.1	± 0.3
1FN3900	0.9	1.3		88.0	--	--	76.1	± 0.3

Continuous load motor: Installation dimensions

Table 5- 2 Dimensions for the air gap and installation dimensions for installing the motor, according to figure above

	Rated air gap with secondary section cover	Rated air gap without secondary section cover		Installation dimension with precision cooler and with secondary section cooler	Installation dimension with precision cooler and without secondary section cooler	Installation dimension without precision cooler and without secondary section cooler	Installation dimension without precision cooler and with secondary section cooler	Tolerance of the installation dimensions
1FN3..-xN	[mm]	[mm]		h_{M1} [mm]	h_{M2} [mm]	h_{M3} [mm]	h_{M4} [mm]	[mm]
1FN3050 1FN3100	0.9	1.3		74.3	71.3	59.4	62.4	± 0.3
1FN3150	0.9	1.3		76.3	73.3	61.4	64.4	± 0.3
1FN3300	0.9	1.3		92.9	89.9	78	81	± 0.3
1FN3450	0.9	1.3		94.9	91.9	80	83	± 0.3
1FN3600	0.9	1.3		99.9	--	--	88	± 0.3
1FN3900	0.9	1.3		101.9	--	--	90	± 0.3

NOTICE

An air gap that is smaller than the rated air gap increases the risk of a motor failure.

A reduction of the mounting dimension is not recommended. The motor becomes more robust by increasing the mounting dimensions.

5.4 Motor installation procedures

General procedures

There are three different procedures for installing a linear motor in a machine:

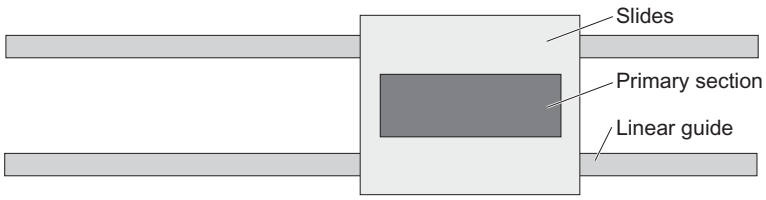
- Assembly with divided secondary section track
- Assembly through the insertion of the slide
- Assembly through the mounting of the motor components

Motor assembly with divided secondary section track

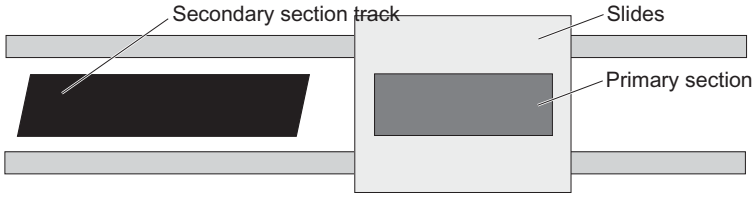
The easiest way is to assemble the motor with a divided secondary section track. The prerequisite is that the entire secondary section track can be divided into two sections, of which each has at least the length of the slide. During assembly, you must work against the attraction force of the secondary sections.

Procedure

① Assembly of the slide including the linear guide and the primary section



② Move the slide to one side and mount the secondary section on the other side. Align the secondary section track and tighten the fastening screws as per the specifications

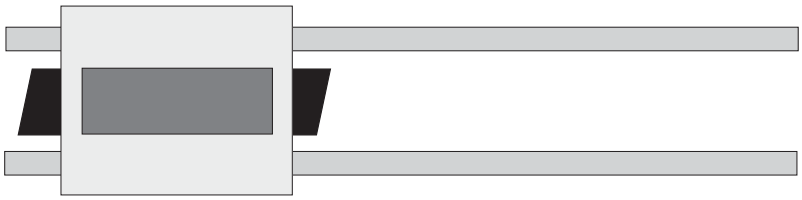


⚠ WARNING

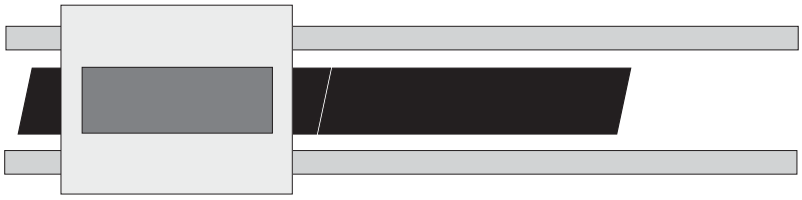
When moving the primary section onto the secondary section track (Step 3), drawing forces towards the secondary section will occur for a short time. Danger of crushing!

Make sure that your fingers do not reach into the danger zone!

③ Push the slide over the mounted secondary section track. The attraction forces are taken up by the linear guides.



③ Assembly of the remaining secondary section track. Also align the track and tighten the fastening screws as per the specifications.



Motor assembly through the insertion of the slide

If the secondary section track cannot be divided into several sections – e.g. because the total length of the secondary section track is too short or with a double-sided motor – the moving component of the motor (slide) can be inserted in the stationary housing with the already installed motor components, see following figure. Normally, a special engaging device is used for this.

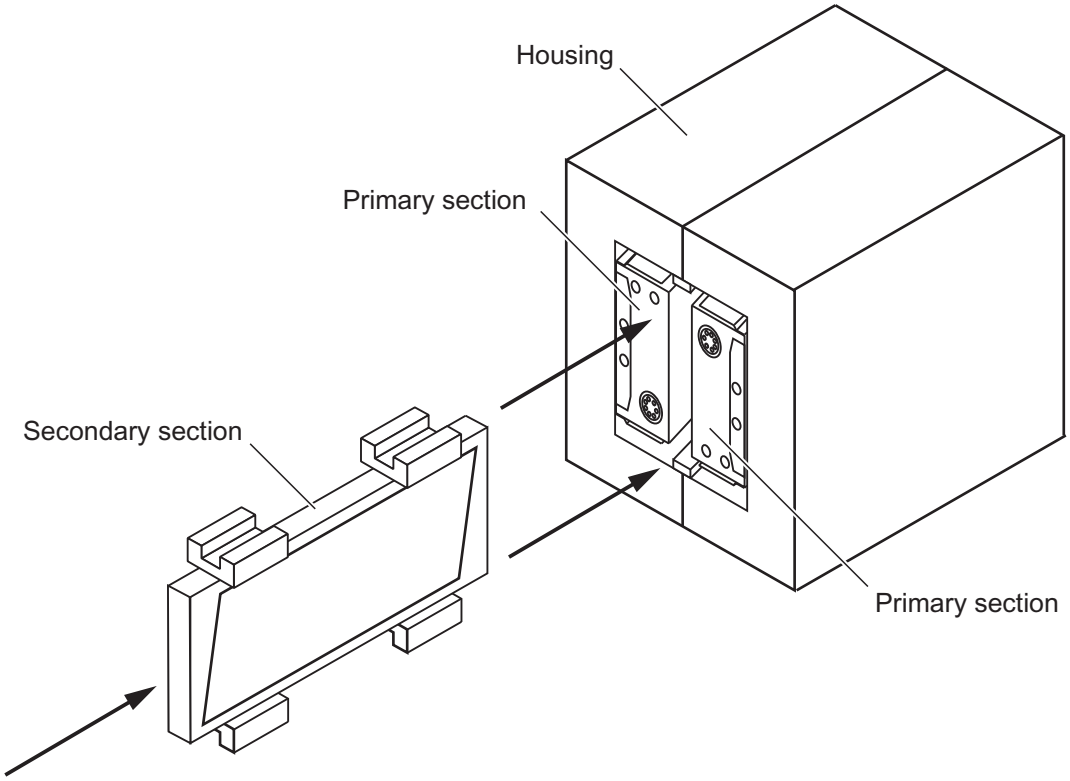


Figure 5-2 Insertion of the secondary section with a double-sided motor

⚠ WARNING

In this procedure, drawing forces towards the stationary motor component occur. Danger of crushing!

The guide must take hold before the slide plate is inserted in the magnetically active section.

Before inserting ferromagnetic components of the linear motor into the active zone of the stationary motor component, remember that guiding or supporting elements (motor bearing) must already be effective!

Motor assembly through the mounting of the motor components

In the third motor assembly process, a non-magnetic spacer plate is positioned between the primary section and secondary section track. This spacer plate prevents the motor from being dragged firmly onto the secondary section when touching down, meaning it can no longer be moved. It must be made of non-magnetizable material and be approximately 20 mm thick.

The slide is then pressed over the primary section and both units are screwed together. This procedure is the most difficult of the described procedures. It should be used only if the other procedures are not possible.

⚠ WARNING

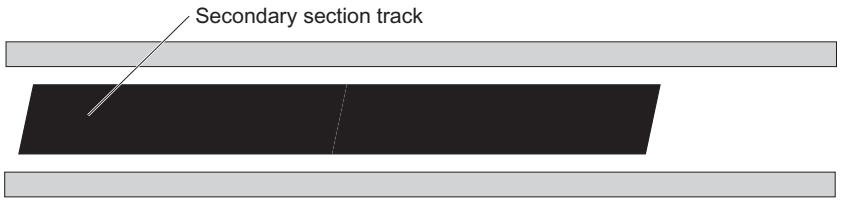
When the primary section is being mounted, high attraction forces (up to 30kN) act in the direction of the secondary section track. Danger of crushing!

For this type of mounting, an assembly is required that enables controlled lowering of the primary section.

The stiffness of the screw-on plate and the length of the fastening screws must be selected in such a way that the primary section can be lifted after touching down.

Procedure

① Assembly of the secondary section track



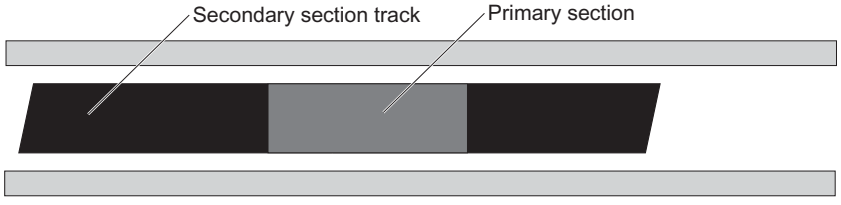
② Moving the primary section, incl. spacer plate, down onto the secondary section track

⚠ WARNING

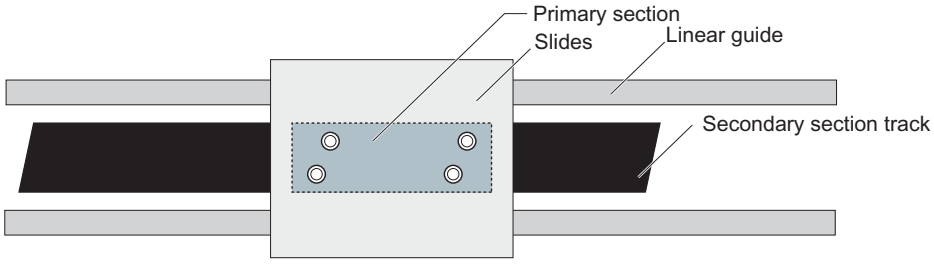
Danger of crushing when mounting the primary section on the secondary section!

Never place the primary section directly onto the secondary section, but rather use a spacer plate made of non-magnetizable material (e.g. a board made of hard wood).

Lay the primary section with the spacer plate onto the secondary section track and center it parallel to the track.



③ Mounting on the slide
The primary section is raised when the slide is evenly screwed into place. The spacer plate can then be removed. By lowering the complete slide unit, the rated air gap between the primary and secondary section can be adjusted.



5.5 Assembling individual motor components

Assembly of the secondary sections

The secondary sections are force-fitted to the machine bed using the fastening screws. The optional cooling sections that can be installed are screwed onto the secondary sections in between the secondary sections and the machine bed. The mounting dimensions without secondary section cooling are reduced by the height of the cooling sections.

Note

The shaft of the bolts, which are used to attach the secondary section to the machine base may not reach the thread. If required, the appropriate hole in the machine base must be lowered.

For each secondary section, the letter N located on the secondary sections must always point in the same direction, see following figure.

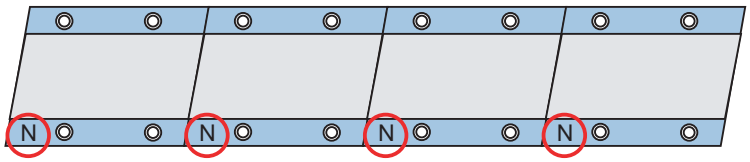


Figure 5-3 Position of the "N" mark on 1FN3 secondary sections

The secondary sections are screwed down in the order shown in the following figure.

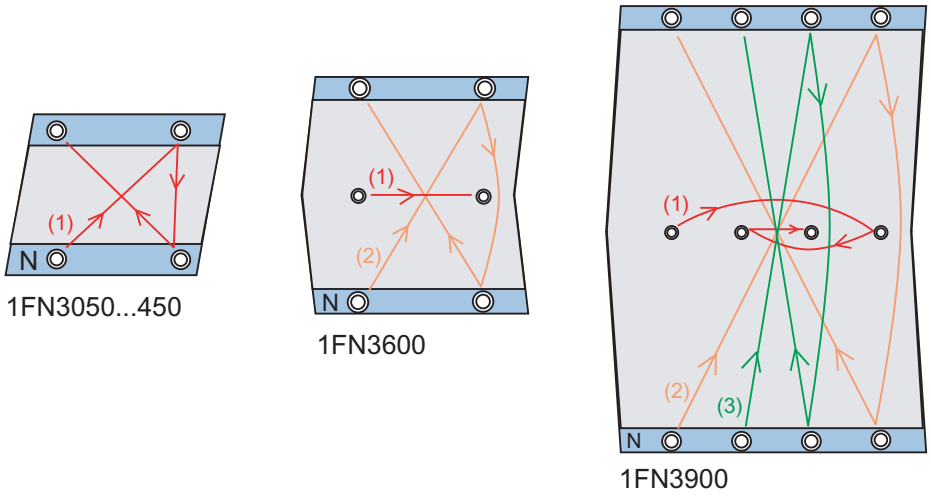


Figure 5-4 Screwed joint sequence of 1FN3 secondary sections

DANGER

There is a high risk of crushing fingers etc. when handling unpacked secondary sections!

It is essential to observe the regulations when handling components with permanent magnets!

Assembly of the secondary section cooling system

If the secondary section cooling system is used, the cooling sections and secondary section end pieces are to be mounted before assembling the secondary sections.

In order to attach the secondary section end pieces, the wedges must be removed. The mounting screws for the wedges are standard steel socket head cap screws (hex socket, DIN 7984 M3x6). Stainless steel fillister-head screws (Phillips head H1, DIN 7985 M3x8) may be used as well. The respective number of screws for each option is specified in the following table.

To mount the secondary section end pieces, use the same screws as for mounting the secondary sections.

Table 5- 3 Number of mounting screws for the wedge of the secondary section end pieces

	1FN3...						
	050	100	150	300	450	600	900
Combi adapter	4	6	6	6	8	--	--
Combi end piece	4	6	6	6	8	--	--
Combi distributor	4	6	6	6	8	10	14
Cover end piece	2	5	5	6	7	--	--

If cooling sections with plug-in connectors are used, proceed as follows:

1. At first, only fix the cooling sections with a few screws so that all threads in the machine bed are visible. These screws have to be removed later, so do not tighten too much!
2. Slide secondary section end piece No. 1 without wedge axially onto the plug-in connectors of the cooling sections.
3. Screw in the mounting screws of secondary section end piece No. 1, but do not tighten.
4. Slide secondary section end piece No. 2 without wedge axially onto the plug-in connectors of the cooling sections.
5. Screw in the mounting screws of secondary section end piece No. 2, but do not tighten.
6. Tighten the mounting screws of the secondary section end pieces.
7. Check cooling circuit for leaks (pressure check at a maximum of 10 bar).
8. Check again whether all threads in the machine bed are visible.
9. Screw the secondary sections together with the cooling sections. But first remove the fastening screws!
10. Mount the secondary section end piece wedges if the cover band is not used as a secondary section cover.

Note

Removing the fastening screws too early may result in excessive deformation and overload of the plug-in connectors due to the tare weight of the cooling sections, especially with a vertically arranged secondary section track. Therefore, especially with a vertically arranged secondary section track, remove the screws used to position the cooling sections step by step.

The following figure shows how to position and attach the heatsink profiles and combi distributors.

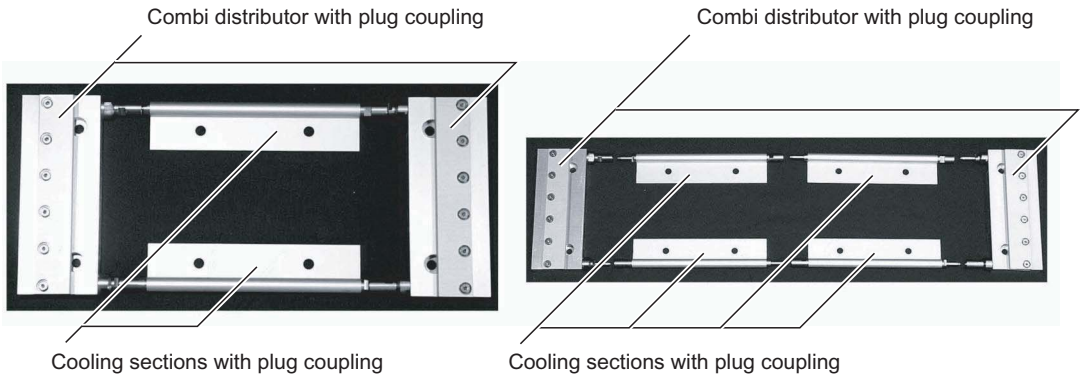

Combi distributor with plug coupling
Combi distributor with plug coupling
Cooling sections with plug coupling
Cooling sections with plug coupling

Figure 5-5 Position of the heatsink profiles and combi distributors (illustration without fastening screws)

Assembly of the secondary section cover

The secondary section cover protects the secondary section track. The assembly method depends on the type of cover used. Two different variants are available:

- Continuous cover band
- Segmented cover

Cover band

The cover band is used in environments with heavy dust loads which could deposit in the spaces of the segmented cover.

NOTICE
Contamination in the motor compartment can cause the motor to stop functioning or cause wear and tear! Irrespective of the use of the cover band, the motor area must be suitably protected from contamination and dirt! The use of scrapers to keep the air gap free is not sufficient and is not recommended.

Covering long secondary section tracks with cover bands is more complicated than with segments.

If the traversing distance of the axis is greater than twice the slide length, proceed as follows:

1. Mount the primary section below the slide.
2. Push the slide on one side of the traversing distance and mount the secondary sections on the other side up to the middle of the traversing distance.
3. Mark the length of the mounted secondary sections plus the required clamping length on the cover band.
4. From the mark, slide the cover band under the primary section to the side without secondary sections. Starting from the mark, place the other half onto the secondary sections.
5. Push the slide over the covered secondary sections. The magnetic forces are taken up by the guides.
6. Lift the cover band carefully from the machine frame and mount the remaining secondary sections underneath.
7. Place the second half of the secondary section cover onto the secondary section track.
8. Lock both ends on the secondary section end pieces using the wedges.

If the traversing distance of the axis is less than twice the slide length or access for mounting the secondary section cover is limited, proceed as follows:

1. Assembly of the secondary sections with the slide plate removed.
2. Starting from one end, place the magnetic secondary section cover onto the secondary sections and fasten both ends on the secondary section end pieces with the wedges.

3. Place the primary section with spacer and extractor onto the secondary section track.
4. Mount the slide onto the guide. Align the slide with the mounting holes of the primary section.
5. Release the primary section from the secondary section track using the extractor and fix it to the slide.

Segmented cover

Mounting the segmented cover is usually easier than mounting the cover band:

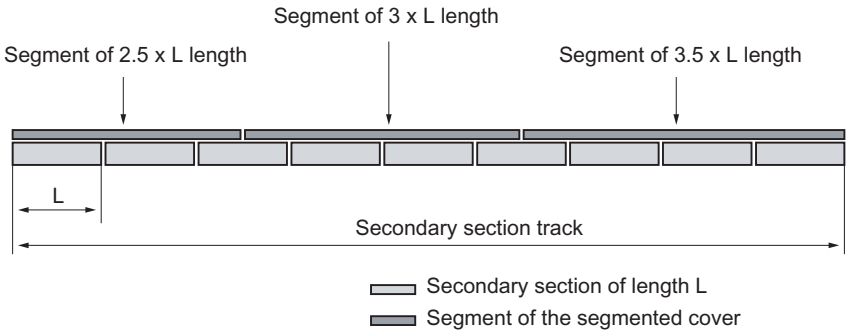
1. Mounting the first segment:
   Position the edge of the first segment from the top in an angle of 45° flush with the outer edge of the last secondary section and lower it in alignment with the secondary section track. As soon as you feel the magnetic attraction force, the segment can be released: It will align itself to the correct position.
2. Checking the correct position:
   The first cover segment should reach to the center of a secondary section.
3. All other segments are mounted the same way as the first one.

The following figures show Steps 1 and 3.

Figure 5-6 Mounting of the first segment of the segmented secondary section cover

Figure 5-7 Mounting of a further segment of the segmented secondary section cover

It is recommended that the butt joints of the cover segment be offset to the butt joints of the secondary sections, see also Step 2. In this way the secondary section track is protected better against dust and the cover segments join better with one another. This offset is achieved when the cover segments at the ends of the secondary section track have a (n+0.5) length instead of the integral length of the secondary sections, see following figure.


Segment of 3 x L length
Segment of 2.5 x L length
Segment of 3.5 x L length
L
Secondary section track
Secondary section of length L
Segment of the segmented cover

Example: Segment position of the segmented secondary section cover

To demount the segmented secondary section cover, lift the segments on one side transverse to the travel direction, see following figure.

Figure 5-8 Demounting a segment of the segmented secondary section cover

Assembling the primary section

The primary section is screwed to the primary section back via the threaded bore holes in a friction-locked joint. Note that the terminal end of the primary section usually points in the same direction as the north pole mark “N” on the secondary sections.

⚠ CAUTION

Wrong bore hole depths for the fastening screws can damage the motor components or, due to an insufficiently solid attachment of the motor components to the machine, cause other unfavorable conditions.

Note the maximum and minimum bore hole depths for the fastening screws!

Assembling of the Hall sensor box

⚠ CAUTION

Incorrect installation of the Hall sensor box can result in uncontrollable travel movements of the motor and damage to the machine. The precise installation dimensions for the Hall sensor box are specified in Chapter 16.

Starting at a certain minimum distance, the distance between the primary section and the Hall sensor box can only be increased by the multiple of the pole pair width $2\tau_M$ - specified in the diagrams as count factor N_P.

The cable outlet direction and position of the Hall sensor within the Hall sensor box are permanently assigned to one another. Therefore, be sure to follow the respective installation diagrams when installing the Hall sensor box with regard to position and alignment with the primary section.

Note

If several primary sections are operated on one drive system (e.g. with PARALLEL arrangement), the master is always to be used as reference for the Hall sensor box.

Be sure to mount the Hall sensor box so that a distance of x = 35 mm between the top of the Hall sensor box and the bottom of the primary section is maintained, see following figure.

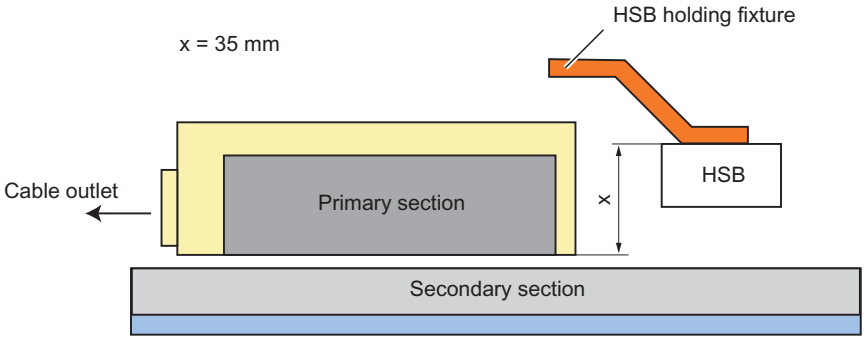


Figure 5-9 Specified dimension for mounting the Hall sensor box (HSB)

The Hall sensor box cable is trailable and may therefore be integrated into tow chains.

Connection

6

6.1 Connection of the cooling system

Connection system

Please note the following for the connection of the cooling system:

- All connections should be flexible (hoses)
- All material used must be resistant to the local environmental conditions
- All materials must be compatible
- Manufacturer's information regarding mounting are to be observed.

Prerequisites for the connection

All cooling connectors for the primary section main cooler and primary section precision cooler are equipped with a G1/8 pipe thread according to DIN 2999. Corresponding connectors are required for the hose connections.

⚠ CAUTION
Use only new, unused connectors! The connector and gasket materials must be checked for compatibility with each other and with the cooling medium used!

Properties of the sealing materials used:

- Viton: heat- and glycol-resistant
- Buna N: resistant to a water temperature of 80 °C
- Ethylene-propylene: heat- and glycol-resistant

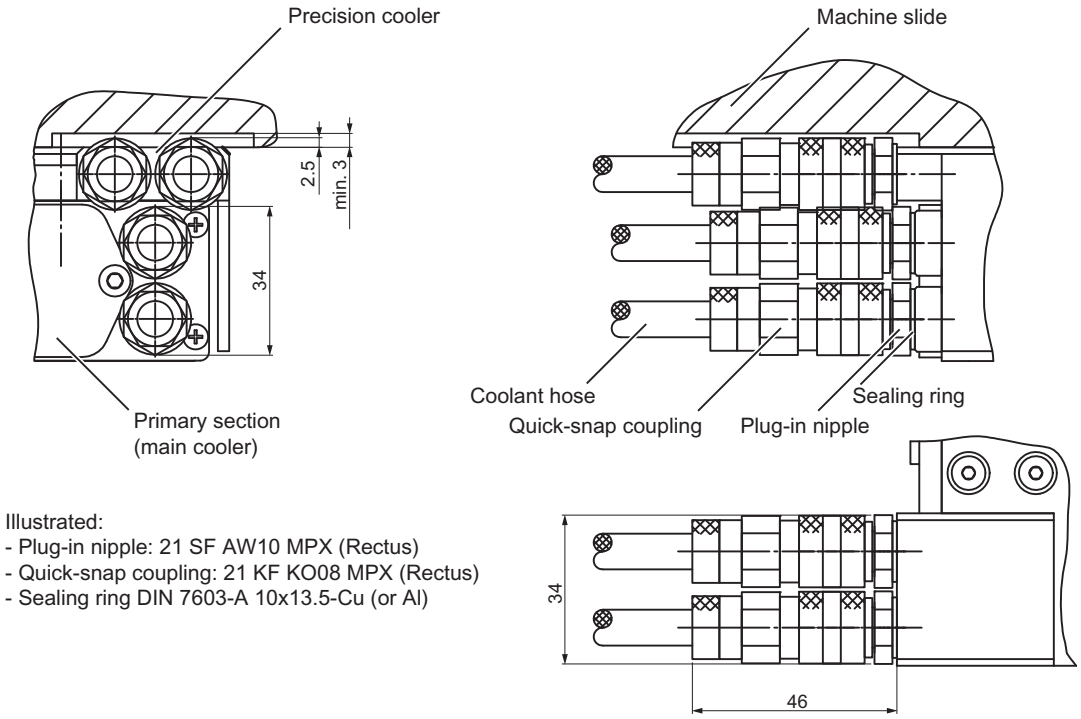
Recommended manufacturers
Recommended manufacturers of connectors for cooling 1FN3 motors are listed in the appendix.

Mounting

The connector assembly can generally be performed with standard tools.

Cutout on the machine slide

If the connecting structure of the primary section protrudes beyond the primary section in the traversing direction, a cutout on the machine slide above the cooling connections must be provided for the connectors, see example in the following figure.



Illustrated:
- Plug-in nipple: 21 SF AW10 MPX (Rectus)
- Quick-snap coupling: 21 KF KO08 MPX (Rectus)
- Sealing ring DIN 7603-A 10x13.5-Cu (or Al)

Figure 6-1 Example of a cooling connection with a cutout on the machine slide

Connection options

For 1FN3 motors, secondary section end pieces can be used for the intake and return lines of the secondary section cooling system. As an alternative, if the continuous secondary section cover band is not used, the plastic hoses can be connected directly to the cooling sections using hose connector nipples.

Properties of the plastic hose

The plastic hoses must be resistant to the cooling medium, flexible and abrasion resistant.

Recommended manufacturers
Recommended manufacturers of plastic hoses are listed in the appendix

Connection via secondary section end pieces

To connect plastic hoses to secondary section end pieces, screwed connectors with screwed nipples and reinforcing sleeves can be used. However, the plastic hoses can also be attached with hose clamps over the hose connector nipples.

For this connection, be sure to note the maximum outer diameter (12 mm) and the maximum square span (width across flats 10) of the screwed joint or the screwed nipple: If larger screw joints or screwed nipples are used, the connection point of the secondary section must be fitted with corresponding cutouts.

Screwed nipples can be sealed to the end piece by using an axial-acting O-ring, a sealing ring or a thread sealer. It is recommended to use conical nipples.

Recommended manufacturers
Recommended manufacturers of screwed connections with nipples and reinforcing sleeves are listed in the appendix.

Position of the connections for secondary section end pieces

G 1/8 threaded connectors are used to connect the secondary section cooling system. These are located on the front faces of the secondary section end pieces.

For models with combi distributors, the intake is located on one side of the secondary section track and the runback on the opposite side, see also the following figure.

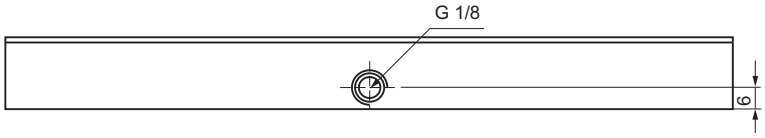


Figure 6-2 Position of the connection elements of the secondary section cooling system with combi distributor (face view)

For models with combi adapter / combi end piece, the cooling medium intake and runback are located on the combi adapter, see following figure.

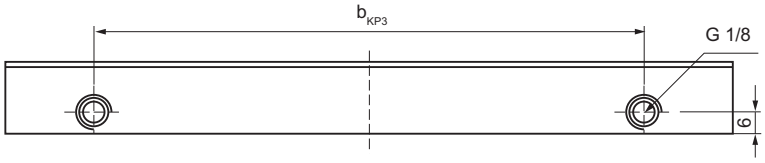


Figure 6-3 Position of the connection elements of the secondary section cooling system with combi adapter (face view)

Table 6- 1 Connector dimensions of the secondary section cooling system with combi adapter (available only for 1FN3050…450)

Motor type	b_{KP3} [mm]
1FN3050	40
1FN3100	40
1FN3150	100
1FN3300	50
1FN3450	100

Direct connection

To connect plastic hoses directly, cooling sections with hose connector nipples can be ordered from Siemens. The inside diameter of the hose should be 5 mm. Hose and hose connector nipple are connected with a hose clamp.

6.2 Electrical connection

6.2.1 Safety instructions

⚠ DANGER

Parts of electrical devices may be under voltage. There is a risk of electric shock.

A hazardous voltage is present at the motor terminals when the primary section is moving. All work involving the electrics must always be carried out by skilled personnel when the device is disconnected from the power supply and the motor is at a standstill.

The regulations for working on electrical installations must be strictly observed. In particular, the following safety rules for working on electrical installations in accordance with DIN EN 50110-1/BGV A3 must be observed:

- Disconnecting the system
- Secure against switching back on
- Make sure that the equipment is de-energized
- Ground and short-circuit
- Cover or cordon off adjacent live parts

It is only possible to work on electrical devices when they are de-energized. The protective conductor should be the first thing to be connected and the last to be disconnected.

All cables in safety extra-low voltage circuits (PELV), for example temperature sensor cables, must meet the requirements of protective separation in accordance with DIN EN 61800-5-1.

DANGER

There is a danger of death, serious bodily injury (electrical shock) and/or property damage if direct drives are connected incorrectly.

The motors may only be connected according to the instructions. Direct connection of the motors to the three-phase supply is not permissible.

Consult the documentation of the drive system being used.

DANGER

Any movement of primary sections in relation to secondary sections leads to induced voltages at the motor connections. Risk of electric shock!

Motor power connections must be properly connected and insulated.

Protective measures against residual voltages

DANGER

There is a shock hazard danger due to the residual voltages at the motor terminals!

When the power supply voltage is switched-out, active parts of the motor can have a charge of more than 60 µC. In addition, at open-circuit cable ends - e.g. when a connector is withdrawn - even after the power has been disconnected, a voltage or more than 60 V can be present for 1 s. This is the reason that you must apply the appropriate measures to provide protection against residual voltages!

DANGER

Risk of electric shock!

For a fault in the motor, a voltage up to the magnitude of the converter DC link voltage can be present at the connector for the temperature sensors or at the cable ends of the temperature sensors.

For temperature sensor cables (PTC and KTY), the directives for protective separation to power circuits according to DIN EN 61800-5-1 (previously protective separation according to DIN EN 50178) must be implemented outside the motor.

6.2.2 Electrical connections on the motor

Internal wiring of the primary section

The following figure shows the internal wiring of the primary section.

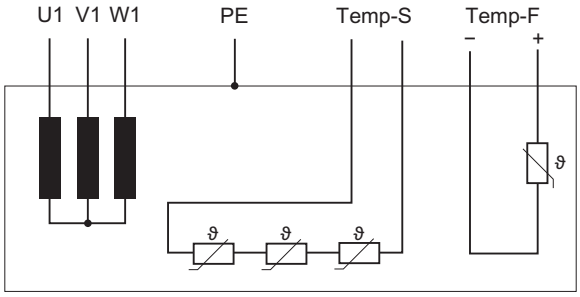


Figure 6-4 Internal wiring of the primary section

Variant with one common connection cable (as standard only for peak load motors)

As standard, this connection variant is only intended for the peak load motor. If required, it can be retrofitted for the continuous load motor. Here, 4 power conductors (3 phase and PE) and 2x2 conductors for the temperature sensors are connected directly to the integrated terminal panel. Angular ring cable lugs are used at the ends of the cables.

Conductor assignment of a prefabricated cable to be connected at the motor is shown in the following diagram.

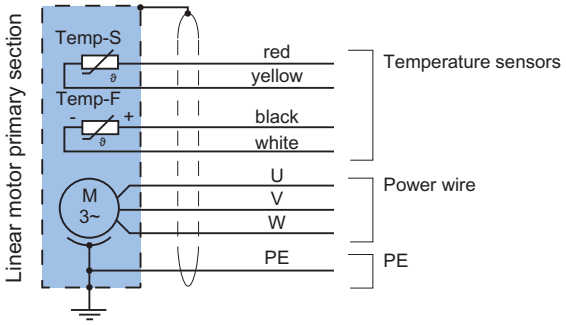
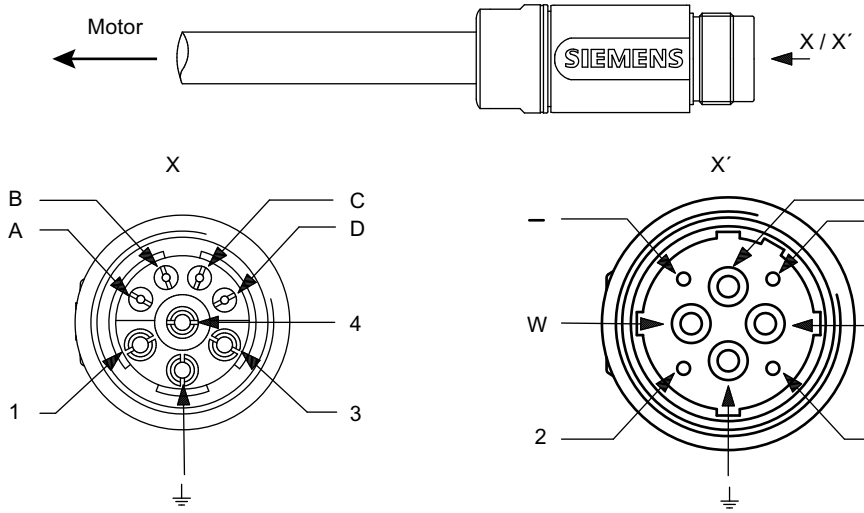


Figure 6-5 Conductor assignment with one connection cable to the motor



Connector size 1

Conductor	Pin
U	1
V	4
W	3
⏚	⏚
Temp-S / PTC	A
Temp-S / PTC	B
Temp-F + / KTY +	C
Temp-F - / KTY -	D

Connector size 1.5

Conductor	Pin
U	U
V	V
W	W
⏚	⏚
Temp- S / PTC	1
Temp- S / PTC	2
Temp- F + / KTY +	+
Temp- F - / KTY -	-

Figure 6-6 Pin assignment of a connection cable

The cables must be connected to the motor with EMC-compliant, metal PG screwed cable glands. This allows cable connections with low bending radii in all directions.

Prefabricated adapter cables 6FX7002-5LMx**0** with straight heavy-gauge threaded joint and connector are available for the "Motion-Connect" connection system, but also direct cables 6FX7002-5LMx**5** without connector. These cables allow quick connection to the motor using angular ring cable lugs and heavy-gauge threaded joints with an integrated EMC-compliant shield. Order numbers can be found in the catalog or on the Internet at https://eb.automation.siemens.com using the search term "Motion-Connect".

Variant with two isolated connection cables (as standard for peak load and continuous load motor)

This connection method can be used for both motor types and consists of 4 power conductors (3 phase and PE) and 2x2 conductors for the temperature sensors, which are connected to the terminal panel in separate cables. The cables are routed into the terminal panel using two metric screwed cable glands.

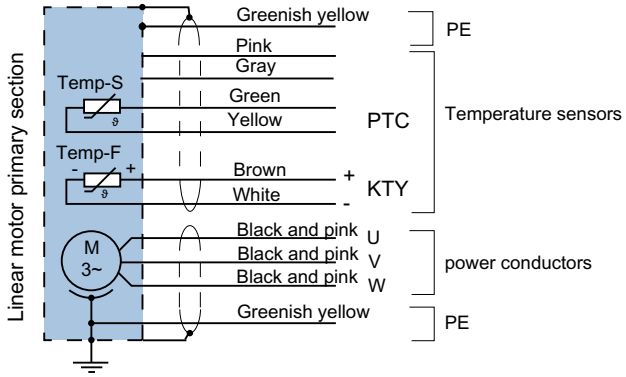
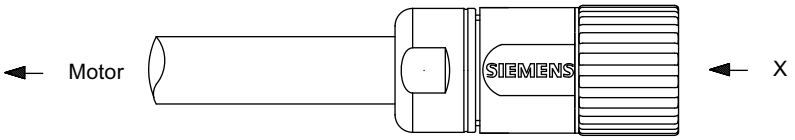


Figure 6-7 Conductor assignment with two connection cables to the motor



Signal connector size M 17

Conductor	Pin
Temp- F - / KTY -	1
Temp- F + / KTY +	2
Temp- S / PTC	3
Temp- S / PTC	4
---	5
---	6
⏚	⏚

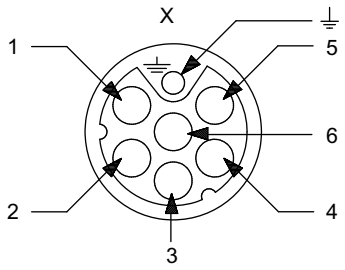
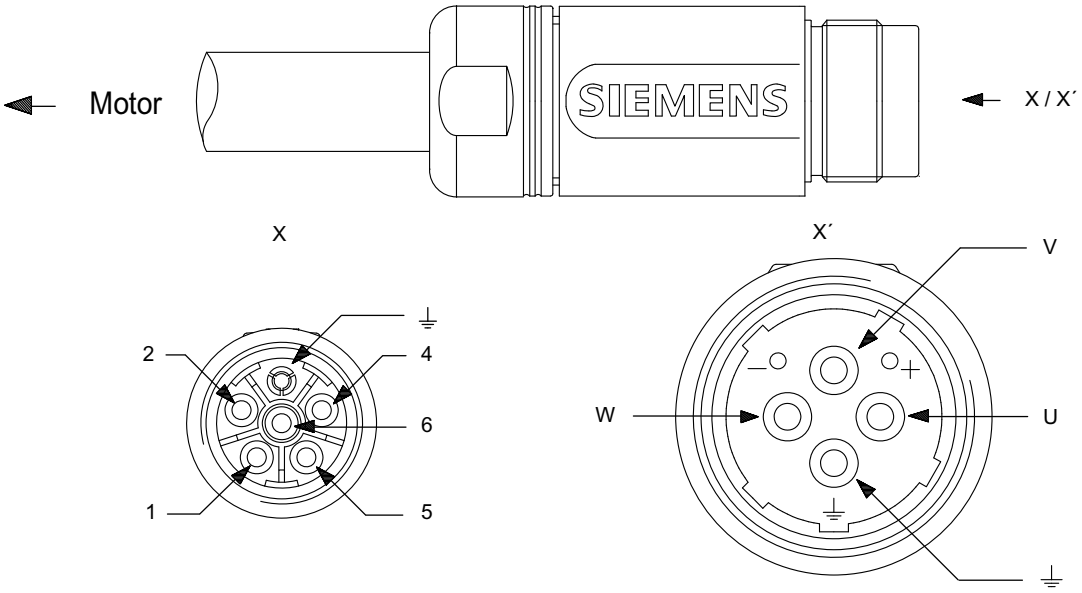


Figure 6-8 Pin assignment of the signal connection cable



Connector size 1

Conductor	Pin
U	1
V	2
W	6
⏚	⏚
---	4
---	5

Connector size 1.5

Conductor	Pin
U	U
V	V
W	W
⏚	⏚
---	+
---	-

Figure 6-9 Pin assignment of the power connection cable

1FN3050

1FN3050 motors are delivered with two permanently connected cables for power and signals. There is a choice of 0.5 m length and prefabricated connectors (size 1 or M17) or 2 m length and open ends.

1FN3100 - 1FN3900

On the motors 1FN3100 - 1FN3900 the isolated power supply and signal cables are connected directly to the integrated terminal panel via a connection cover with metric screw connections.

A combined cable variant is also available for the peak load motors in this range. This is connected to the terminal panel via a connection cover with heavy-gauge threaded joint.

The electrical connection to a sensor module (e.g. SME12x) is easier and the use of a terminal strip can be avoided by separating the power and signal cables.

Number of conductors and cable cross-sections

Cables that are connected to the motor must have four conductors for the power cable / four conductors for the signal cable. The cross-section for each of the signal cable conductors is 0.5 mm^2. The cross-section of the power cable conductors is based on the rated current of the motor. The rated current of the motor must be less than the current carrying capacity of the cable according to DIN EN 60204-1 (laying system C). The table below specifies the maximum permissible rated current of the motor for different cross-sections of the power cable conductors.

Table 6- 2 Maximum permissible rated current with different cross-sections of the power cable conductors.

Power cable conductor cross-section	2.5 mm^2	4 mm^2	6 mm^2	10 mm^2	16 mm^2	25 mm^2
Maximum permissible rated current	21 A	28 A	36 A	50 A	66 A	84 A

NOTICE

Connection of large cable cross-sections

Connecting cables with conductors of more than 16 mm^2 is not possible at the motor terminal panel. If the rated current of a motor requires power conductors with a cross-section of 25 mm^2, please contact your local Siemens office.

Terminal panel

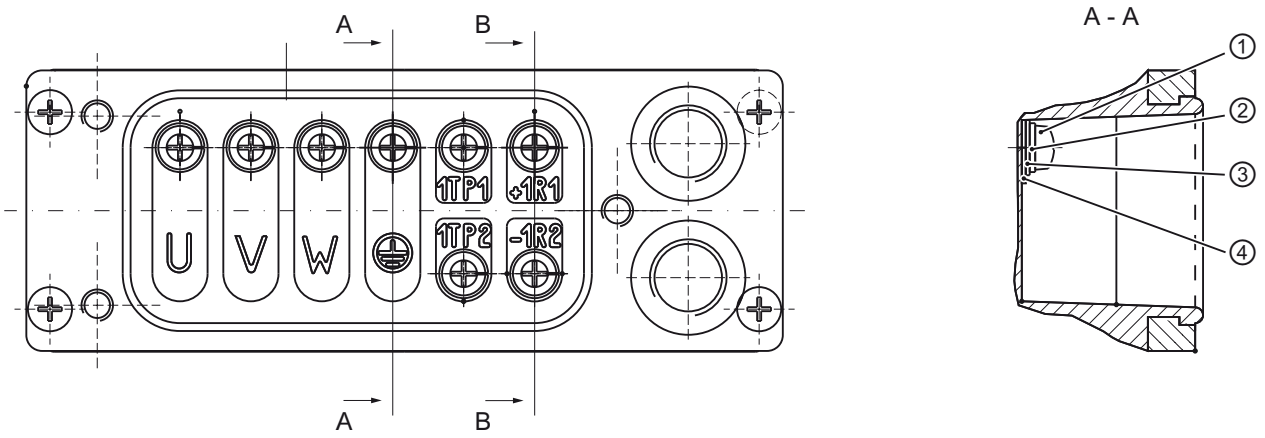
Note

The terminal panel is not easily accessible with a preinstalled primary section. It is therefore recommended to premount the primary section with an open end cable and to run this cable to an easier accessible terminal.

The following figures show the terminal assignment of the terminal panel for various peak load motor types. The terminal panel of peak load and continuous load motors is identical. The only difference is that the dimensions of the casing are larger on the continuous load motor. However, this is of no significance for the electrical connection.

Note

With the EN 60034-8:2002 standard the terminal markings have changed. For the old terminal markings, see Appendix.

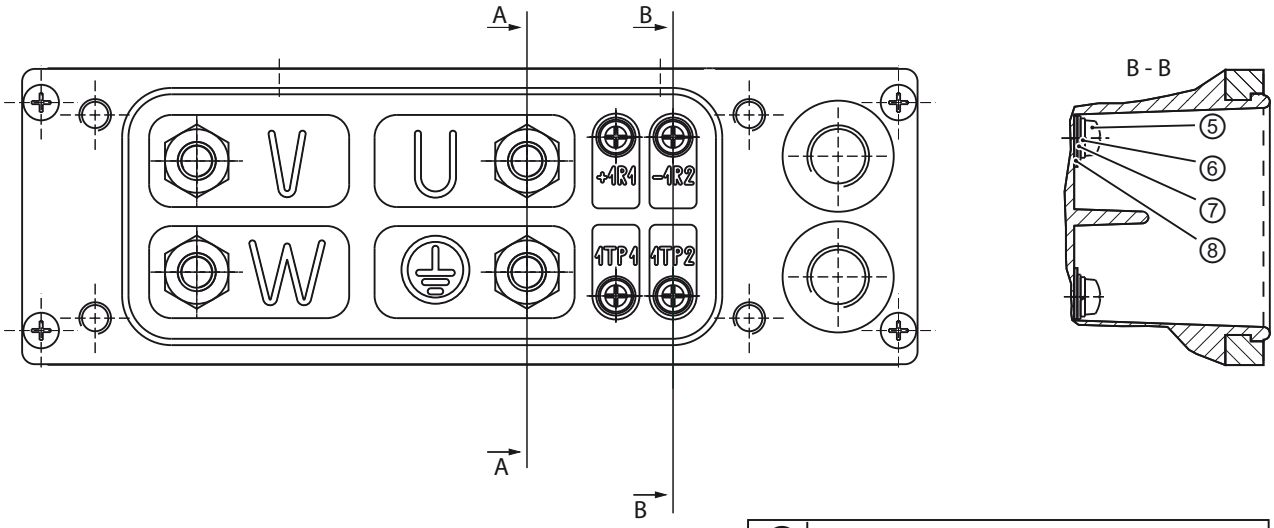


Legend

U	Phase U
V	Phase V
W	Phase W
⏚	Grounding
1TP1	Temp-S (PTC)
1TP2	Temp-S (PTC)
+1R1	Temp-F (KTY 84) ⊕
-1R2	Temp-F (KTY 84) ⊖

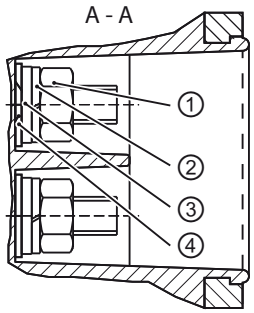
①	Phillips head fillister-head screw ISO 7985-M3x10-A2; Tightening torque: 0.6 Nm ... 0.8 Nm
②	Spring washer DIN 128-A 3.1-Fst
③	Washer DIN 125-A 3.2-A2
④	e.g. crimp cable lug DIN 46234; Not included with the primary section!

Figure 6-10 Terminal panel for the motors 1FN3100 to 1FN3150



Legend

U	Phase U
V	Phase V
W	Phase W
⏚	Grounding
1TP1	Temp-S (PTC)
1TP2	Temp-S (PTC)
+1R1	Temp-F (KTY 84) ⊕
-1R2	Temp-F (KTY 84) ⊖



①	Nut ISO 4032-M6-A2; Tightening torque: 6 Nm ... 7 Nm
②	Spring washer DIN 128-A 6.1-Fst
③	Washer DIN 125-A 6.4-A2
④	e.g. crimp cable lug DIN 46234; Not included with the primary section!
⑤	Phillips head fillister-head screw ISO 7985-M3x10-A2; Tightening torque: 0.6 Nm ... 0.8 Nm
⑥	Spring washer DIN 128-A 3.1-Fst
⑦	Washer DIN 125-A 3.2-A2
⑧	e.g. crimp cable lug DIN 46234; Not included with the primary section!

Figure 6-11 Terminal panel for the motors 1FN3300 to 1FN3900

The supplied screws and the tightening torques are listed in following table.

Table 6- 3 Connection cover screws supplied and tightening torques

Motor type 1FN3...	Screw compliant with DIN EN ISO 4762	Tightening torque
100, 150	M4x20–A2	2.2 Nm
300, 450, 600, 900	M5x20–A4	3.4 Nm

Disassembly of the connection cover

CAUTION
The seal can be damaged during disassembly of the connection cover! When unscrewing the connection cover, take care that the seal stays completely in the groove in the connection cover! If necessary, carefully loosen the seal from the motor and push it back into the groove in the connection cover.

Conductor assignment

The following figure shows the conductor assignment when connecting a peak load motor to the terminal strip using prefabricated cables.

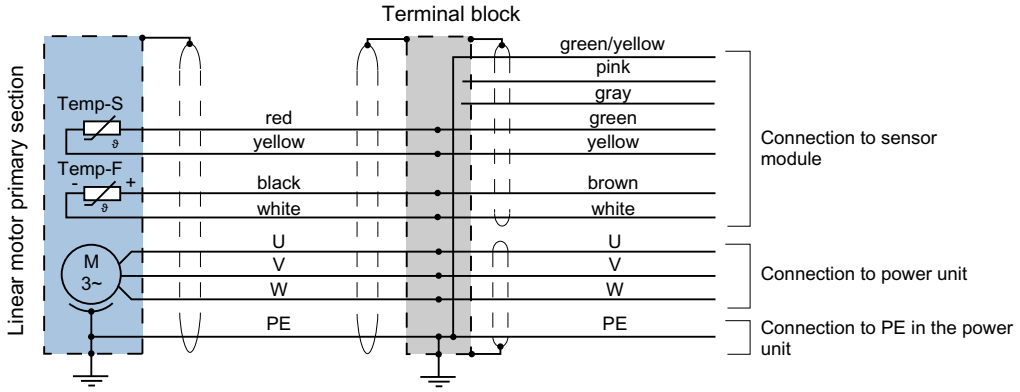


Figure 6-12 Conductor assignment when connecting prefabricated cables to the terminal block.

6.2.2.1 Connection of the power and signal cables

The power cables are connected directly or via an intermediate terminal to the designated positions on the power module. Take the shielding and grounding into account!

In the same way, the signal cables are connected directly or via an intermediate terminal to a sensor module.

6.2.3 Cable routing regulations

General notes for routing electric cables

NOTICE
Drives with linear motors are subject to a high dynamic load. It must be ensured that vibration is not transferred to the plug connector by suitably routing the cable and by providing strain relief close to the plug connector (distance < $10d_{Kabel}$).

When routing electrical cables, observe the following:

- The cables must fulfill the following requirements:
  - Sufficiently high dynamic-mechanical strength (to withstand high acceleration rates and velocities)
  - Thermal stability up to 80° C (static) or 60° C (dynamic)

  The recommended MOTION-CONNECT® cables fulfill these requirements.
- The cables may not chafe anywhere
- The cables must be clamped or fixed into place after a maximum of 200 mm
- Always observe the manufacturer's specifications regarding installation.
- The permissible bending radii must be adhered to.

Using the cables in the cable carrier

NOTICE
When laying cables, carefully observe the instructions given by the cable carrier manufacturer!

To maximize the service life of the cable carrier and cables, cables in the carrier made from different materials must be installed in the cable carrier with spacers.

The chambers must be filled evenly to ensure that the position of the cables does not change during operation. The cables should be distributed as symmetrically as possible according to their mass and dimensions.

If possible, use only cables with equal diameters in one chamber. Cables with very different outer diameters should be separated by spacers.

The cables must not be fixed in the carrier and must have room to move. It must be possible to move the cables without applying force, in particular in the bending radii of the carrier.

The specified bending radii must be adhered to. The cable fixings must be attached at both ends at an appropriate distance away from the end points of the moving parts in a dead zone.

A tension relief must be installed at least at the ends of the cable carrier. Be sure to mount the cables along the casing without crushing them.

The cables are to be taken off the drum free of twists, i.e. roll the cables off the drum instead of taking them off in loops from the drum flange.

6.2.4 Shielding, grounding, and equipotential bonding

Rules

Correct installation, correctly connecting cable shields and protective conductors is very important, not only for the safety of personnel but also for the effect on interference emission and interference immunity. Therefore, the following must be carefully observed:

- All cable shields must be connected to the respective housing using clamps or suitable terminal or screwed connectors
- Connecting only a few shield conductors or combining shield conductors in one cable is not permitted
- Connect the power cable shield at the shield connection of the power module.
- Apply the EMC installation guideline of the converter manufacturer. For Siemens converters, this is available under Order No. 6FC5297-□AD30-0AP□.

⚠ DANGER

Risk of electric shock!

Hazardous touch voltages can be present at unused cores and shields if they have not been grounded or insulated.

Unused cores of unshielded or shielded cables and their shields must either be connected at one end to the grounded housing potential or they must be insulated. The insulation must be able to withstand the rated voltage.

Electrical charges that are the result of capacitive cross coupling are discharged by connecting the cores and shields.

NOTICE

Unshielded or incorrectly shielded cables can lead to faults in the drive – particularly the encoder – or in external devices.

Note the topics mentioned above!

NOTICE
High leakage currents may damage other devices if the motor PE is not directly connected to the power unit. Connect the motor protective conductor (PE) directly at the power unit.

Commissioning 7

The motor can only be commissioned when it has been installed in a machine and integrated in a functioning system. The commissioning documentation of all the system components, e.g. the documentation of the drive, encoder and cooling system, must be taken into account for the commissioning. The appropriate configuration manual and these operating instructions contain important information for the commissioning of the motor.

Note

The commissioning of the linear motor depends on the drive system used (e.g. SINAMICS S120) and the system components used.

It is essential that only authorized and trained personnel commission the motor, and that the entire commissioning documentation of the system components is available and taken into account.

7.1 Safety instructions

⚠ DANGER

Danger due to high leakage currents

If high leakage currents are present, more stringent requirements may apply to the PE conductor. Warning signs may also be required on the PDS. You can find more detailed information in the standard DIN EN EN 61800-5-1.

⚠ WARNING

The surface temperature of the motors may be more than 100 °C (212 °F). Risk of burns

Make sure that the cooling system (if available) is working properly.

Do not touch the motor during/directly after use.

Display the "Hot Surface Do Not Touch" (D-W026) warning sign clearly in the vicinity of the motor.

Temperature-sensitive parts (electric cables, electronic components) may not be placed on hot surfaces.

⚠ DANGER

There is a danger of death, serious bodily injury and/or property damage if a machine is commissioned which does not meet the recognized safety requirements.

⚠ DANGER

Unexpected movements of the motor may present a danger of death, serious bodily injury (crushing) and/or property damage.

Never reach into the moving parts of the machine when it is switched on.

Keep persons away from moving parts and areas where there is a danger of crushing.

Make sure the machine can move unobstructed.

Check the commutation before switching on. Also observe the instructions of the drive system being used.

Limit the motor currents.

Set the velocity limit to low values.

Monitor the end positions of the motor.

Requirements

- The motor is fully mechanically installed and the screws have been tightened to the specified torque.
- All connectors on the motor have been connected properly and the wiring has been completed.
- Motor components, such as the position measuring system, temperature monitoring, and cooling system are connected.
- The control and power modules of the drive system are configured.

Checks in the no-current state

1. Linear motor
   - Which linear motor is being used?
   - Is the motor ready to start?
   - If a cooling circuit is being used, is it working correctly?
2. Mechanical
   - Is the axis easy to move over the complete traversing range?
   - Does the air gap between the primary and secondary section and the installation dimension correspond to the motor manufacturer's specifications?
   - Is this a suspended axis, and is a counterweight in place if needed?
   - Is a brake being controlled correctly (see the SINAMICS S Function Manual)?
   - Are mechanical limit stops in place and tightly bolted to both ends of the traversing path?
   - Are moving supply lines correctly routed in a tow chain assembly?
3. Measuring system
   - Which position measuring system is being used (incremental / absolute; scale divisions; zero marks)?
   - Which is the positive drive direction?
   - Where is the positive counting direction of the measuring system (if necessary perform inversion: p0410 ⇒ yes / no) ?
4. Wiring
   - Is the power module connected properly (connect UVW, phase sequence, clockwise rotating field)?
   - Is the protective conductor connected?
   - Is the shielding in place?
   - Are the temperature monitoring circuits (Temp-F and Temp-S) wired according to the requirements listed in the chapter "Connecting the motor"?
   - Is the encoder system connected properly to SINAMICS?

7.2 Checking by measurement

Why make measurements?

If the linear motor was commissioned according to the relevant instructions, and unexplained fault messages still occur, then all of the EMF signals must be checked using an oscilloscope.

Checking the phase sequence U-V-W

For primary sections connected in parallel, the EMF_U from motor 1 must be in phase with the EMF_U from motor 2. The same is true for EMF_V and EMF_W.
It is absolutely necessary that this is checked by making the appropriate measurements.

Taking the necessary measurements

- Disconnect the drive line-up from the power supply.
- Note: Wait until the DC link has been discharged!
- Disconnect the power cables from the drive.
  Disconnect any primary components connected in parallel.
- Form an artificial neutral point using 1 kOhm resistors.

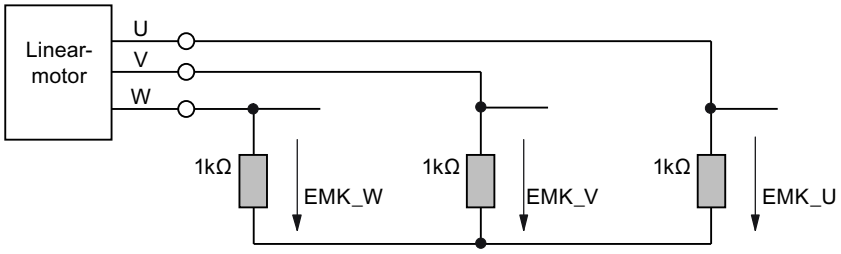


Figure 7-1 Configuration for checking by measurement

For a positive traversing direction, the phase sequence must be U-V-W.

Determining the commutation angle using an oscilloscope

Once the oscilloscope has been connected, the drive must first pass the zero mark so that fine synchronization can be carried out.

The angular, commutation offset can be determined by measuring the EMF and normalized electrical pole position via an analog output.

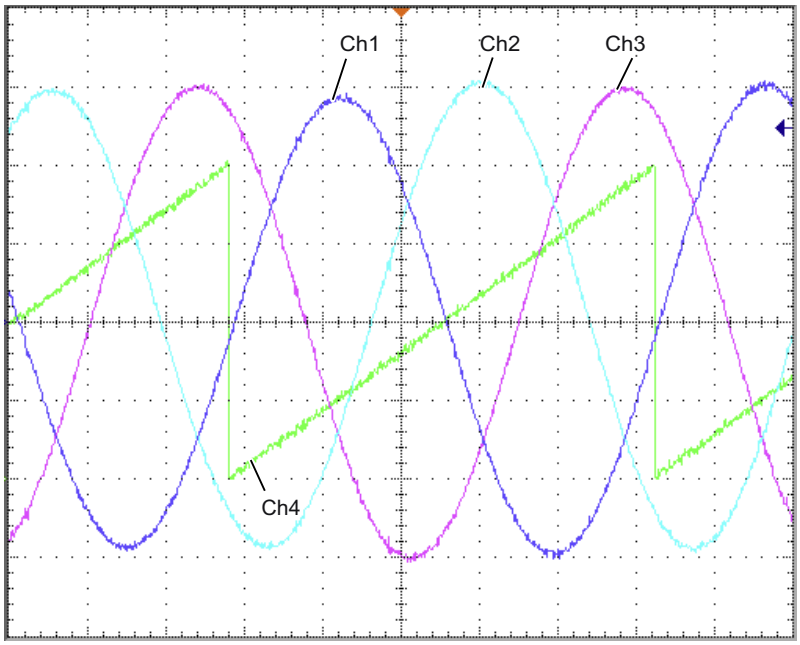


Figure 7-2 Oscillogram for setting the commutation angle

Definition of channels (Ch1 to Ch4):

- Ch1: EMF phase U to neutral point
- Ch2: EMF phase V to neutral point
- Ch3: EMF phase W to neutral point
- Ch4: Normalized electrical angular pole position via analog output

When the drive is synchronized, the difference between the EMF/phase U (Ch 1) and the electrical angular pole position (Ch 4) is a maximum of 10°.

If the difference is greater, the commutation angle offset must be adjusted.

7.3 Commissioning multiple, parallel primary sections

General Information

If you are sure that the EMFs of more than one motor have the same phase relation to one another, the connecting cables can be connected in parallel and operated on one converter.

Parallel linear motors are commissioned based on the commissioning of a single linear motor. The number of primary sections is entered in the STARTER tool using the menu item "Motor" (p0306) during drive configuration.

Note

Prerequisites for parallel connection of linear motors

Which primary sections can be connected in parallel and what needs to be observed when doing so is described in the chapter "Motors connected in parallel".

Procedure

- First, only one linear motor (motor 1) is connected to the converter and is commissioned as an individual motor. The commutation angle offset is automatically determined and noted.
- One of the other motors is then connected in place of motor 1 and commissioned as an individual motor. The commutation angle offset is also automatically determined and noted.
- If the difference between the commutation angle offset of motor 1 and the other motors is less than 10 degrees electrically, all linear motors can be connected to the converter in parallel and commissioned with parallel connection.

Temperature sensor connection

The evaluation of the temperature switches takes place via the connection to a sensor module.

Operation 8

8.1 Safety instructions

⚠ DANGER

Machine parts driven by direct drives pose a considerable danger of injury – e.g. crushing – due to the very high speed and acceleration and the low friction and self-inhibition.

Keep persons clear of the moving parts and areas of the axes where there is a danger of crushing!

⚠ WARNING

Improper operation can lead to serious property damage.

Check continuously whether the temperature protection is effective!

Keep the motor area free from foreign bodies (chips, particles, liquids, oils, screws, tools, etc.)!

Listen for noise!

If there are accuracy problems with the workpiece, check the freedom of movement and the current consumption of the motor. Accuracy problems may also have other causes, e.g. the machine design.

Make sure the cooling system is working properly if available!

8.2 Switching off and operating phases

During downtimes, deposits must not be produced that can block the cooling system. Check with the manufacturer of the coolant as to how long it can remain in the cooling system.

8.3 Dealing with faults

If there are deviations from normal operation or if faults occur, initially proceed according to the following list. In this regard, observe the relevant chapters in the documentation associated with the components of the complete drive system.

Even in test operation, never disable protective functions or devices.

NOTICE
Damage to the machine caused by faults
Correct the cause of the fault as specified in the remedial measures section. Repair any damage to the machine/motor.

Table 8- 1 Possible faults

Fault	Cause of the fault (see following table)												
Motor does not start	A	B	C	D									
Motor starts up slowly	A			D	E								
Humming noise when starting				D	E								
Humming noise during operation	A			D	E								
High temperature rise during no-load operation				D		F	G						
High temperature rise when under load	A			D		F	G						
Overheating of individual winding sections					E								
Uneven running								H	J				
Grinding sound, running noise										K			
Axis is sluggish					E					K	L		
Water is leaking													N

Table 8- 2 Key to causes of faults and remedial measures

No.	Cause of fault	How to remedy the problem
A	Overloading	Reduce load
B	Interrupted phase in the supply cable	Check frequency converter and supply cables
C	Interrupted phase in the supply cable after switching on	Check frequency converter and supply cables
D	Motor commutation is faulty	Check the commutation, if required re-adjust the commutation angle offset
E	Winding short-circuit or phase short-circuit in the primary section winding	Measure the winding resistances and insulation resistances, motor replacement after consultation with the manufacturer
F	Cooling water not connected / switched off	Check cooling water connection / switch on cooling water / check cooler
	Water connection / pipes defective	Locate leaks and seal as necessary, or consult the manufacturer
G	Cooling water flow rate too low	Check cooling water flow rate according to data sheet specification
	Intake temperature too high	Set correct intake temperature
H	Insufficient shielding for motor and/or encoder cable	Check the shielding and grounding
J	Drive controller gain too high	Adjust the controller

No.	Cause of fault	How to remedy the problem
K	Motor components are rubbing	Determine cause and adjust components
	Foreign bodies in the air gap	Consult the manufacturer
	Guide rail is tight	Check that the guide rails are not distorted and are parallel to one another
L	Poor alignment	Align machine guides
M	Shocks from coupled machine	Check coupled machine
N	Cooling water pipes/water connection defective	Locate leaks and seal as necessary, or consult the manufacturer

If the fault still cannot be resolved after applying the measures specified above, please contact the manufacturer or your local Siemens office.

Maintenance 9

9.1 Safety instructions

Safety guidelines for maintenance

⚠ DANGER

There is a danger of death, serious bodily injury and/or property damage when maintenance work is performed with the machine switched on.

Always isolate the machine reliably from the power supply before working in areas with moving parts! The machine must also be secured against unwanted movements.

⚠ DANGER

If work is carried out on the motor immediately after it has been in operation, there is a risk of burns if you come into contact with hot surfaces. The cooling water temperature can also increase after the motor has already been switched off.

To cool the motor down to the level of the inlet temperature T_{VORL}, the cooler must remain in operation for at least 30 minutes after the motor has been switched off. If the cooler is switched off, however, it takes significantly longer for the motor to cool down. This depends to a large extent on the installation situation.

⚠ DANGER

Risk of burns

Risk of pressure surges: Do not switch the cooler on if the motor was operated without a cooler beforehand. The major build-up of steam can cause burns or destroy the motor.

When you open the cooling circuit, there is a risk of burning when the hot cooling water and steam escapes. If the motor is operated with the cooler, the cooling water in the cooling system heats up.

Do not open the motor cooling circuit until the motor has cooled down.

The motors have been designed for a long service life. Carefully ensure that maintenance work is correctly performed, e.g. removing chips and particles from the air gap.

For safety reasons it is not permissible to repair the motors:

⚠ DANGER

Risk of death, serious bodily injury and/or material damage if the safety-relevant motor properties are changed.

Examples of changed safety-relevant motor properties:

- Damaged insulation does not protect against arcing. There is a risk of electric shock!
- Damaged sealing no longer guarantees protection against shock, ingress of foreign bodies and water, which is specified as IP degree of protection on the rating plate.
- Diminished heat dissipation can result in the motor being prematurely shut down and in machine downtime.

Do not open the motor.

Note

If incorrect changes or corrective maintenance are carried out by you or a third party on the contractual objects, then for these and the consequential damages, no claims can be made against Siemens regarding personal injury or material damage.

Siemens service centers are available to answer any questions you may have. Siemens Service Center addresses can be found at http://www.automation.siemens.com/partner/

⚠ WARNING

Sharp edges can cause cuts and falling objects can injure feet.

Always wear work gloves and safety shoes.

Notes for checking the insulation resistance

⚠ WARNING

An insulation resistance inspection under high-voltage conditions can damage the motor insulation!

If insulation resistance inspections need to be carried out on a machine/plant with direct drives or directly on the motors (e.g. installation inspection, preventive maintenance, troubleshooting), only inspection devices that comply with DIN EN 61557-1, DIN EN 61557-2, and DIN EN 61010-1 (or the relevant IEC standards) can be used.

The inspection may only be carried out with a maximum direct voltage of 1000 V for a maximum time of 60 s! The test voltage should be measured with respect to ground or the motor enclosure. If a higher DC or AC voltage is necessary for the purposes of inspecting the machine/plant, you must arrange the inspection with your local Siemens office.

Please follow the operating instructions for the inspection device!

Inspections of the insulation resistance on individual motors must always be carried out as follows:

1. Connect all winding and temperature sensor connectors with each other; inspection voltage not to exceed 1000 VDC, 60 s against PE connection.
2. Connect all temperature sensor connectors to the PE connector and all winding connectors with each other; the inspection voltage must not exceed 1000 VDC, 60 s, winding against PE connector.

Each insulation resistance must be at least 10 MΩ, otherwise the motor insulation is defective.

9.2 Maintenance

Measures to lengthen the service life

Because of their principle of operation, direct drives are in principle free of wear. To ensure the function and the freedom from wear of the motor, the following maintenance work is necessary:

- Check for freedom of movement regularly
- Clear foreign objects (e.g. chips) regularly from the motor area
- Check the general condition of the motor components regularly
- Check the current consumption in a fixed test cycle (compare with values of the reference run)

Intervals between maintenance

Since operating conditions differ greatly, it is not possible to specify intervals between maintenance work.

Indications that maintenance work is required

- Dirt in the motor cabinet
- Distinctive changes in the behavior of the machine
- Unusual sounds emitted by the machine
- Problems with positioning accuracy
- Higher current consumption

Test and replacement intervals of the cooling medium

The test and replacement intervals for the cooling medium should be agreed with the manufacturers of the anti-corrosion agent and the cooling system.

Decommissioning and disposal 10

10.1 Decommissioning

Sequence when decommissioning and disassembling the motor

DANGER

A different sequence when decommissioning and disassembling the motor can endanger personnel and/or destroy motor components.

1. Disconnect the motor and wait until the DC link of the power unit has discharged.
2. Let the motor cool down (at least 30 minutes), then shut down the cooling and reduce the pressure to 0 bar.
3. Disconnect the power and signal cables and the coolant lines.
4. If required, insulate the power connections correctly because any motion of primary sections with respect to secondary sections induces voltages.
5. Empty the coolant from the motor and dispose of it correctly.
6. Remove chips, dirt, foreign particles, etc. from the motor.
7. Disassemble the primary section depending on the installation procedure. For example, with installation with divided secondary section track, first move the primary section to one end of the secondary section track and disassemble the uncovered secondary sections. Then move the primary section to the end without secondary section and remove the remaining secondary section track. Only then disassemble the slide together with the linear guide and the primary section.
8. Pack the motor in the original packaging and store it correctly.

10.2 Disposal

The product must be disposed of in the normal recycling process in compliance with national and local regulations.

⚠ DANGER

Death, serious bodily injury and/or property damage may result from improper disposal of direct drives or their components (especially components with permanent magnets).

Direct drives or their components must be disposed of properly.

Main constituents of a proper disposal procedure

- Complete demagnetization of the components that contain permanent magnets
- Components that are to be recycled should be separated into:
  - Electronics scrap (e.g. encoder electronics, sensor modules)
  - Electrical scrap (e.g. laminated cores, motor windings, cables)
  - Iron to be recycled
  - Aluminum
  - Insulating materials
- No mixing with solvents, cold cleaning agents, or remains of paint, for example

Demagnetization of the secondary sections

Disposal companies specialized in demagnetization use special disposal furnaces. The insides of the disposal furnace consist of non-magnetic material.

The secondary sections are put in the furnace in a solid, heat-resistant container (such as a skeleton container) made of non-magnetic material and left in the furnace during the entire demagnetization procedure. The temperature in the furnace must be at least 300° C during a holding time of at least 30 minutes.

Escaping exhaust must be collected and made risk-free without damaging the environment.

Disposal of packaging

The packaging and packing aids we use contain no problematic materials. With the exception of wooden materials, they can all be recycled and should always be disposed of for reuse. Wooden materials should be burned.

Only recyclable plastics are used as packing aids:

- Code 02 PE-HD (polyethylene)
- Code 04 PE-LD (polyethylene)
- Code 05 PP (polypropylene)
- Code 04 PS (polystyrene)

Appendix

A

A.1 Siemens Service Center

At

http://www.siemens.com/automation/service&support

you can find Siemens contacts worldwide for information about specific technologies.

Wherever possible, you will find a local contact partner for:

- Technical support,
- Spare parts/repairs,
- Service,
- Training,
- Sales or
- Technical support/engineering.

You start by selecting a

- Country,
- Product or
- Sector.

Once the remaining criteria have been laid down, the required contact will be shown along with the associated area of expertise.

A.2 1FNx declaration of conformity

EC declaration of conformity of the 1FNx linear motor

SIEMENS

EG-Konformitätserklärung
EC Declaration of Conformity

No. 400006446-04

Hersteller: SIEMENS AG
Manufacturer: I DT MC MF-M EWM

Anschrift: Georg-Reismüller-Str. 32
Address: 80999 München

Produkt: **Drehstrom-Linearmotoren, Typ 1FNx...**
Product *Built-in three-phase synchronous motors, type 1FNx...*

Die bezeichneten Produkte stimmen in der von uns in Verkehr gebrachten Ausführung mit den Vorschriften folgender Europäischer Richtlinien überein:

The products described above in the form as delivered are in conformity with the provisions of the following European Directives:

2006/95/EG Richtlinie des Rates zur Angleichung der Rechtsvorschriften der Mitgliedstaaten betreffend elektrische Betriebsmittel zur Verwendung innerhalb bestimmter Spannungsgrenzen.

Council Directive on the approximation of the laws of the Member States related to electrical equipment designed for use within certain voltage limits.

CE-Kennzeichnung: siehe Anhang A (5 Seiten) / *CE marking: see Annex A (5 pages)*

Die Konformität mit den Richtlinien wird nachgewiesen durch die Einhaltung der zutreffenden Kapitel folgender Normen:

Conformity to the Directives is assured through the application of the applicable sections of the following standards:

Referenznummer *Reference number*	Referenznummer *Reference number*
DIN EN 60034-1	EN 60204-1

München, 23.02.2011
Siemens AG I DT MC MF-M EWM

Dipl.-Ing. (FH) Georg Ketzer Werksleitung Name, Funktion *Name, function*	i.V. Unterschrift *signature*	Dipl.-Ing. Christian Volmert Leitung Entwicklung Name, Funktion *Name, function*	Unterschrift *signature*
Dipl.-Ing. (FH) Konrad Freundorfer Approbationsbeauftragter Name, Funktion *Name, function*	Unterschrift *signature*		

Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Richtlinien, ist jedoch keine Zusicherung von Eigenschaften.
Die Sicherheitshinweise der mitgelieferten Produktdokumentation sind zu beachten.
This declaration certifies the conformity to the specified directives but contains no assurance of properties. The safety documentation accompanying the product shall be considered in detail.

Seite 1 von 1

SIEMENS

Anhang A zur EG-Konformitätserklärung Nr. 400006446-04
Attachment A to EC Declaration of Conformity No. 4000006446-04

Lfd. Nr.	Komponente	Bestellbezeichnung	Erstmalige CE-Anbringung
1	Primärteil	1FN107x-xxxxx-xxxx	1997
2	Primärteil	1FN112x-xxxxx-xxxx	1997
3	Primärteil	1FN118x-xxxxx-xxxx	1997
4	Primärteil	1FN124x-xxxxx-xxxx	1997
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SIEMENS

Anhang A zur EG-Konformitätserklärung Nr. 400006446-04
Attachment A to EC Declaration of Conformity No. 4000006446-04

Lfd. Nr.	Komponente	Bestellbezeichnung	Erstmalige CE-Anbringung
1	Primärteil	1FN2045-xLxxx-xxxx	2000
2	Primärteil	1FN2090-xJxxx-xxxx	2000
3	Primärteil	1FN2090-xLxxx-xxxx	2000
4	Primärteil	1FN2090-xWxxx-xxxx	2000
5	Primärteil	1FN2135-xWxxx-xxxx	2000
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SIEMENS

Anhang A zur EG-Konformitätserklärung Nr. 400006446-04
Attachment A to EC Declaration of Conformity No. 4000006446-04

Lfd. Nr.	Komponente	Bestellbezeichnung	Erstmalige CE-Anbringung
1	Primärteil	1FN3050-xWxxx-xxxx	1999
2	Primärteil	1FN3100-xWxxx-xxxx	1999
3	Primärteil	1FN3150-xWxxx-xxxx	1999
4	Primärteil	1FN3300-xWxxx-xxxx	1999
5	Primärteil	1FN3450-xWxxx-xxxx	1999
6	Primärteil	1FN3600-xWxxx-xxxx	1999
7	Primärteil	1FN3900-xWxxx-xxxx	1999
8	Primärteil	1FN3300-xVxxx-xxxx	2002
9	Primärteil	1FN3450-xVxxx-xxxx	2002
10	Primärteil	1FN3600-xVxxx-xxxx	2002
11	Primärteil	1FN3900-xVxxx-xxxx	2002
12	Primärteil	1FN3050-xNxxx-xxxx	03/2006
13	Primärteil	1FN3100-xNxxx-xxxx	03/2006
14	Primärteil	1FN3150-xNxxx-xxxx	03/2006
15	Primärteil	1FN3300-xNxxx-xxxx	03/2006
16	Primärteil	1FN3450-xNxxx-xxxx	03/2006
17	Primärteil	1FN3600-xNxxx-xxxx	03/2006
18	Primärteil	1FN3900-xNxxx-xxxx	03/2006
19	Primärteil	1FN3050-xKxxx-xxxx	01/2008
20	Primärteil	1FN3100-xKxxx-xxxx	01/2008
21	Primärteil	1FN3150-xKxxx-xxxx	01/2008
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SIEMENS

Anhang A zur EG-Konformitätserklärung Nr. 400006446-04
Attachment A to EC Declaration of Conformity No. 4000006446-04

Lfd. Nr.	Komponente	Bestellbezeichnung	Erstmalige CE-Anbringung
1	Primärteil	1FN4030-xKxxx-xxxx	2001
2	Primärteil	1FN4050-xKxxx-xxxx	2001
3	Primärteil	1FN4070-xKxxx-xxxx	2001
4	Primärteil	1FN4100-xKxxx-xxxx	2001
5	Primärteil	1FN4120-xKxxx-xxxx	2001
6	Primärteil	1FN4150-xKxxx-xxxx	2001
7	Primärteil	1FN4030-xPxxx-xxxx	2001
8	Primärteil	1FN4050-xPxxx-xxxx	2001
9	Primärteil	1FN4070-xPxxx-xxxx	2001
10	Primärteil	1FN4100-xPxxx-xxxx	2001
11	Primärteil	1FN4120-xPxxx-xxxx	2001
12	Primärteil	1FN4150-xPxxx-xxxx	2001
13	Primärteil	1FN4030-xWxxx-xxxx	2001
14	Primärteil	1FN4050-xWxxx-xxxx	2001
15	Primärteil	1FN4070-xWxxx-xxxx	2001
16	Primärteil	1FN4100-xWxxx-xxxx	2001
17	Primärteil	1FN4120-xWxxx-xxxx	2001
18	Primärteil	1FN4150-xWxxx-xxxx	2001
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SIEMENS

Anhang A zur EG-Konformitätserklärung Nr. 400006446-04
Attachment A to EC Declaration of Conformity No. 4000006446-04

Lfd. Nr.	Komponente	Bestellbezeichnung	Erstmalige CE-Anbringung
1	Primärteil	1FN6003-xxxxx-xxxx	2008
2	Primärteil	1FN6007-xxxxx-xxxx	2008
3	Primärteil	1FN6008-xxxxx-xxxx	2008
4	Primärteil	1FN6016-xxxxx-xxxx	2008
5	Primärteil	1FN6024-xxxxx-xxxx	2008
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A.3 Information regarding third-party products

Information regarding third-party products

NOTICE
This document contains recommendations relating to third-party products. This involves third-party products whose fundamental suitability is familiar to us. It goes without saying that equivalent products from other manufacturers may be used. Our recommendations are to be seen as helpful information, not as requirements or regulations. We cannot accept any liability for the quality and properties/features of third-party products.

A.4 Manufacturers of anti-corrosion agents

TYFOROP CHEMIE GmbH	
Anti-corrosion protection: Tyfocor	www.tyfo.de

Clariant Produkte (Deutschland) GmbH	
Anti-corrosion protection: Antifrogen N	www.clariant.de

A.5 Manufacturers of connectors for cooling

Rectus GmbH	
	www.rectus.de

A.6 Manufacturers of plastic hose manufacturers

Festo AG & Co. KG	
	www.festo.com

Rectus GmbH	
	www.rectus.de

Abbreviations and glossary

Abbreviations

BGR	Employer's Liability Insurance Association Regulations; Health and safety at work regulations (in Germany)
BGV	Employer's Liability Insurance Association Regulations; Binding regulations for health and safety in the workplace in Germany; Accident prevention regulations
CE	Communaute Europeene
DIN	Deutsches Institut für Normung (German standards organization)
EC	European Community
EMC	Electromagnetic Compatibility
EMK	Electromotive force
EN	European standard
FAQ	Frequently Asked Questions
HFD	High-frequency Damping
HSB	Hall Sensor Box
HW	Hardware
IATA	International Air Transport Association
IEC	International Electrotechnical Commission
IP	International Protection or Ingress Protection; type of protection für electric devices according to DIN EN 60529
ISO	International Standardization Organization
KTY	Temperature sensor with progressive, almost linear characteristic
LU	Length Unit
MLFB	Machine-readable product designation; Order number
NC	Numerical Control
PDS	Power Drive System
PE	Protection Earth (protective conductor)
PELV	Protective Extra Low Voltage
PLC	Programmable logic controller
PTC	Temperature sensor with positive temperature coefficient
RoHS	Restriction of (the use of certain) Hazardous Substances
S1	"Continuous operation" mode
S2	"Short-time duty" mode
S3	"Intermittent operation" mode
SME	Sensor Module External
SSI	Synchronous Serial Interface
SW	Software

Temp-F	Circuit for monitoring the temperature of the motor winding
Temp-S	Temperature monitoring circuit for switching off the drive at overtemperature
VDE	Association of Electrical Engineering, Electronics and Information Technology (in Germany)
WMS	Position measuring system; including WMS: incremental position measuring system; abs. WMS: absolute position measuring system

Glossary

Absolute position measuring system

By using several reading tracks, the motor is able to recognize the current position with the absolute position measuring system immediately after switching on. The position is recognized without traversing distance and is transmitted via the serial EnDat interface. The measurement path is limited and more expensive due to the more complex measurement track

Condensation

When the relative humidity in the immediate vicinity of the motor reaches 100%, the excess moisture in the air condenses on the surface of the motor. The resulting water film is called *condensation*.

Incremental position measuring system

To determine the position of the motor in the machine using an incremental position measuring system, the motor must travel to a reference point after being switched on. There are several reference points with the distance-coded incremental position measuring system. Higher speeds can be reached if open incremental encoders are used.

Primary section

The primary section is the electrically active component of a linear motor. Usually this is also the moving component.

Secondary section

In contrast to the → Primary section, the secondary section is not electrically active. The → Secondary section track is made up to secondary sections.

Secondary section track

As a rule, the secondary section track is made up of several → Secondary sections. Usually this is a non-moving component of a linear motor.

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